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Insight Report

The Global Information Technology Report 2014

Rewards and Risks of Big Data

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The Global Information Technology Report 2014 is a special project within the framework of the World Economic Forum's Global Competitiveness and Benchmarking Network and the Industry Partnership Programme for Information and Communication Technologies. It is the result of collaboration between the World Economic Forum and INSEAD.

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ISBN-13: 978-92-95044-63-0
ISBN-10: 92-95044-63-0

This report is printed on paper suitable for recycling and made from fully managed and sustainable forest sources. Printed and bound in Switzerland by SRO-Kundig.

Visit *The Global Information Technology Report* page at **www.weforum.org/gitr**

We thank Hope Steele for her excellent editing work and Neil Weinberg for his superb graphic design and layout.

The terms *country* and *nation* as used in this report do not in all cases refer to a territorial entity that is a state as understood by international law and practice. The terms cover well-defined, geographically self-contained economic areas that may not be states but for which statistical data are maintained on a separate and independent basis.

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Preface

JENNIFER BLANKE and **ALAN MARCUS**
World Economic Forum

The 13th edition of *The Global Information Technology Report* is released at a time when economies need to solidify the recovery of the past year and leave the worst financial and economic crisis of the past 80 years behind. Developed economies need to sustain their incipient economic recovery and find new areas of growth and employment creation; emerging and developing economies need to build their resilience against turbulence in the markets and foster their innovation potential in order to sustain the rapid economic growth they experienced in the past decade.

Against this backdrop, information and communication technologies (ICTs)—in their role as key enablers of innovation and new employment opportunities—are drawing more attention than ever before. As the benefits of ICTs increasingly materialize into tangible assets, building and strengthening digital ecosystems becomes increasingly important.

The GITR series has been published by the World Economic Forum in partnership with INSEAD since 2002. The *Report* has accompanied and monitored ICT progress for more than a decade and raised awareness of the importance of ICTs for long-term competitiveness and well-being. Through the lens of the Networked Readiness Index (NRI), the driving factors and impacts of networked readiness and ICT leveraging have been identified, highlighting the joint responsibility of all social actors—individuals, businesses, and governments.

The Global Information Technology Report 2014 features the latest results of the NRI, offering an overview of the current state of ICT readiness in the world. This year's coverage includes a record number of 148 economies, accounting for over 98 percent of global GDP. In addition, it features a number of essays that inquire into the rewards and risks accruing from big data, an unprecedented phenomenon in terms of the volume, velocity, and variety of sources of the creation of new data. These essays also advise on the changes that organizations, both public and private, will need to adopt in order to manage, make sense of, and obtain economic and social value from this vast quantity of newly generated data. In addition, the *Report* presents a wealth of data, including detailed profiles for each economy covered and data tables with global rankings for the NRI's 54 indicators.

We would like to convey our sincere gratitude to the industry and academic organizations' experts who contributed outstanding chapters. We also wish to thank the editors of the *Report*—Soumitra Dutta at the Samuel Curtis Johnson Graduate School of Management at Cornell University, Bruno Lanvin at INSEAD, and Beñat Bilbao-Osorio at the World Economic Forum—for their leadership in this project, together with the other members of the GITR team: Roberto Crotti, Danil Kerimi, and Elena Kvochko. Appreciation also goes to members of the Global Competitiveness and Benchmarking Network team: Ciara Browne, Gemma Corrigan, Attilio di Batista, Gaëlle Dreyer, Margareta Drzeniek-Hanouz, Thierry Geiger, Tania Gutknecht, Caroline Ko, and Cecilia Serin. Last but not least, we would like to express our gratitude to our network of over 160 Partner Institutes around the world and to all the business executives who participated in our Executive Opinion Survey. Without their valuable input, the production of this *Report* would not be possible.

Foreword

JOHN CHAMBERS
Chairman and Chief Executive Officer, Cisco Systems

I never cease to be amazed by the speed of innovation. Change is the only true constant, and each year the pace of change only accelerates. Transitions that once took place over three or five years now happen in 12 to 18 months.

I believe we are currently experiencing the biggest fundamental change the world has seen since the initial development of the Internet as people, processes, data, and things become increasingly connected. We call this the Internet of Everything (IoE), and it is having a profound impact on individuals, businesses, communities, and countries. According to analysis conducted by Cisco, the Internet of Everything represents a US$19 trillion global opportunity to create value over the next decade through greater profits for businesses as well as improved citizen services, cost efficiencies, and increased revenues for governments and other public-sector organizations.

Several major transitions in technology—each important in its own right—are combining to make the Internet of Everything possible. These include the emergence of cloud and mobile computing, the growth of big data and analytics, and the explosive development of the Internet of Things (IoT). These transitions are changing the role of information technology (IT), with Internet protocol (IP) networks playing an increasingly central part by seamlessly connecting disparate IT environments. Cisco's contribution to this edition of *The Global Information Technology Report* focuses on the how IP networks facilitate new information flows through the interaction between two of these transitions: IoT and data analytics.

The explosive expansion of IoT, or connections between context-aware machines and other physical objects, is changing how we utilize devices to improve our daily lives. And the shift in data and analytics—from being centralized, structured, and static to being distributed, mixed structured and unstructured, and real-time—is leading to a new era of real-time processing and decision-making.

More industries are moving their systems and processes to IP networks, and the rapid growth of IP-connected devices is driving exponential increases in data traffic. The migration to IP networks and the ability to turn "big data" into valuable, actionable information have demonstrable benefits—both economic and social—as well as positive financial impacts for firms.

In our 30-year history, our success has been based on our ability to see around corners, identify market transitions, and make big bets on what is next—such as the emergence of the Internet of Everything. We have seen this before, in the transitions from bridged networks to routed networks, shared networks to switched ones, circuit switching to packet switching, fixed connectivity to mobile connectivity, dedicated resources to virtual ones, data traffic to voice and video traffic, PC connections to any-device connections, and physical data centers to the cloud.

We see the network as the critical accelerator and enabler in all of these transitions, transforming processes to increase efficiency and decrease costs. In data centers, for example, the network is the common element for intelligence, scale, and flexibility. Data centers have evolved as more intelligence has been built into the network—from networking virtual machines and developing a platform optimizing computing to scaling applications and decoupling them from the server or data center in which they live.

The network also facilitates the growth of applications, a key driver of the Internet of Everything. Applications already provide an integral way that consumers experience the Internet of Everything, with the number of applications growing from 10 billion downloads in 2010 to 77 billion by 2014.

As this trend continues, we expect the Internet of Everything to drive massive gains in efficiency, business growth, and quality of life, helped along by thousands of new IoT applications. These applications will require building new end-to-end IoT infrastructures, which will enable the deployment of even more IoT applications.

We are pleased to collaborate again with the World Economic Forum and INSEAD to produce *The Global Information Technology Report* and the Networked Readiness Index (NRI). The NRI provides policymakers, business leaders, and concerned citizens with valuable insights into current market conditions and the state of connectivity across the world, and helps to identify where more can be done to accelerate the Internet of Everything's positive impact on the world in which we live.

Foreword

CESARE MAINARDI
Chief Executive Officer, Booz & Company

The report in your hands is a compilation of wisdom about the relationship between digitization and corporate strategy. This is a relationship of enormous promise, because digitization—the mass adoption of connected digital services by consumers, enterprises, and governments—provides dramatic power and reach to the companies that understand it.

But there is also enormous tension in the relationship between digitization and strategy. Digital media and technologies are inherently subject to change. A company's strategy, its way of winning in the market, is most effective when it is tied to its identity. And corporate identities—and the capabilities and cultures that go with them—are by nature slow to change. It takes years to develop the kind of proficiency that no other company can easily master.

We have found in our research on capable companies that the most consistently successful are those that master this tension. They base their strategies on their distinctive capabilities: the things they do better than any other company. These are consistent throughout their lifetimes. Apple competes on its unique approach to design, which no other company can match; IKEA on its unparalleled prowess in making and selling low-priced but appealing home furnishings; and Haier on its remarkable ability to translate its customers' needs into innovative new appliances. These successful companies then learn to adapt to new challenges and opportunities within the context of their constant identity. They become rapid innovators, able to shift to new products, markets, and geographies, but they adapt only when their existing capabilities can give them the right to win.

For most companies, digitization is a great enabler. But it is also a great disruptor. It enables competitors as well, including competitors from other sectors who might enter your business arena. This can present a threat that can often turn a company's advantage into a weakness.

Digitization is also distracting: it can present a bewildering array of potential opportunities, all of which look compelling. But pursuing them all is both financially unfeasible and strategically distracting. It leads to incoherence, which can lead an enterprise into decline.

How then do capable companies handle the opportunities and challenges of digitization? They are rigorously and prudently selective. They invest in those areas that are in line with their chosen way to play in the market—the distinctive way they create value for their customers.

Consider, for example, the threats, distractions, and benefits of one current element of digitization: big data. This is comprised of large datasets often gathered in unstructured forms from the behavior of people and groups. For example, as individuals search online, shop, express their opinions, communicate with each other, and move from one place to another, their aggregate behavior can be tracked and inferences drawn from it. New technologies, such as analytic engines and cloud-based storage, have made it possible to gather these data in unprecedented amounts and interpret them in novel ways. Insights from old forms of market research, such as asking customers what they liked or did not like in a commercial transaction, now become part of a larger pattern of awareness, with both the scale and granularity to give business people a much clearer view of their market.

In capable companies, big data is aligned with their strategies. They invest only in the data gathering that gives them privileged access to the customers they care about, or that contributes to the capabilities that make them distinctive. Without that discipline, companies can be overwhelmed by big data. They can collect a huge volume of information without any predetermined purpose, and then struggle to make sense of it. In short, the prevalence of massive amounts of new information has only highlighted the importance of the old strategic verity: to change successfully, you must stay true to your identity and seek the customers who you can serve well.

The next few years will see many companies struggling to resolve the tension between change and identity. Those who master the new digital technologies in a disciplined way, in the service of their focused strategies, will become more successful in the market—and the economies around them will thrive accordingly.

Executive Summary

BEÑAT BILBAO-OSORIO, World Economic Forum
SOUMITRA DUTTA, Cornell University
BRUNO LANVIN, INSEAD

When *The Global Information Technology Report* (GITR) and the Networked Readiness Index (NRI) were created more than 13 years ago, the attention of decision makers was focused on how to develop strategies that would allow them to benefit from what *Time Magazine* had described as "the new economy": a new way of organizing and managing economic activity based on the new opportunities that the Internet provided for businesses.[1] At present, the world is slowly emerging from one of the worst financial and economic crises in decades, and policymakers, business leaders, and civil society are looking into new opportunities that can consolidate growth, generate new employment, and create business opportunities. Information and communication technologies (ICTs) continue to rank high on the list as one of the key sources of new opportunities to foster innovation and boost economic and social prosperity, for both advanced and emerging economies.

For more than 13 years, the NRI has provided decision makers with a useful conceptual framework to evaluate the impact of ICTs at a global level and to benchmark the ICT readiness and usage of their economies.

EXTRACTING VALUE FROM BIG DATA

Data have always had strategic value, but with the magnitude of data available today—and our capability to process them—they have become a new form of asset class. In a very real sense, data are now the equivalent of oil or gold. And today we are seeing a data boom rivaling the Texas oil boom of the 20th century and the San Francisco gold rush of the 1800s. It has spawned an entire support industry and has attracted a great deal of business press in recent years.

This new asset class of big data is commonly described by what we call the "three Vs." Big data is high volume, high velocity, and includes a high variety of sources of information. Next to those traditional three Vs we could add a fourth: value. This is what everyone is looking for, and this is why big data today gets so much attention. In the quest for value, the challenge facing us is how to reduce the complexity and unwieldiness of big data so that it becomes truly valuable.

Big data can take the form of structured data such as financial transactions or unstructured data such as photographs or blog posts. It can be crowd-sourced or obtained from proprietary data sources. Big data has been fueled by both technological advances (such as the spread of radio-frequency identification, or RFID, chips) and social trends (such as the widespread adoption of social media). Our collective discussions, comments, likes, dislikes, and networks of social connections are now all data, and their scale is massive. What did we search for? What did we read? Where did we go? With whom do we associate? What do we eat? What do we purchase? In short, almost any imaginable human interaction can be captured and studied within the realm of big data.

Big data has arrived. It is changing our lives and changing the way we do business. But succeeding with big data requires more than just data. Data-based value creation requires the identification of patterns from which predictions can be inferred and decisions made. Businesses need to decide which data to use. The data each business owns might be as different as the businesses themselves; these data range from log files and GPS data to customer- or machine-to-machine data. Each business will need to select the data source it will use to create value. Moreover, creating this value will require the right way of dissecting and then analyzing those data with the right analytics. It will require knowing how to separate valuable information from hype.

This world of big data has also become a source of concern. The consequences of big data for issues of privacy and other areas of society are not yet fully understood. Some prominent critics, such as Jaron Lanier,[2] call on us to be cautious about readily believing any result created by the "wisdom of the crowd." Moreover, applications of big data in military intelligence have created a growing concern for privacy around the world.

Indeed, we are now living in a world where anything and everything can be measured. "Data" could become a new ideology. We are just at the beginning of a long journey where, with the proper principles and guidelines, we should be able to collect, measure, and analyze more and more information about everyone and everything in order to make better decisions, individually and collectively.

PART 1: THE CURRENT NETWORKED READINESS LANDSCAPE

Part 1 of this *Report* presents the latest findings of the NRI, offering a comprehensive assessment of the present state of networked readiness in the world. Furthermore, a number of expert contributions inquiring into the role of big data and how to extract value from it are also included. These contributions relate to (1) how the network unleashes the benefits of big data; (2) how and why policymakers and business executives need to develop action plans to extract value from big data; (3) balancing the risks and rewards of big data from a public policy perspective; (4) managing these risks and rewards; (5) rebalancing socioeconomic asymmetry in a data-driven economy; (6) the role of regulation and trust building in unlocking the value of big data; (7) turning the potential of big data into socioeconomic results; and (8) defining organizational change to take full advantage of big data.

Insights from the NRI 2014 on the world's networked readiness

Chapter 1.1 provides an overview of the networked readiness landscape of the world as assessed by the NRI 2014. It presents the results of the top 10 performers and selected countries by region, in the following order: Europe and the Commonwealth of Independent States, Asia and the Pacific, Latin America and the Caribbean, sub-Saharan Africa, and the Middle East and North Africa.

Tables 1 through 5 report the 2014 rankings for the overall NRI, its four subindexes, and its 10 pillars. In addition, the Country/Economy Profile and Data Tables sections at the end of the *Report* present the detailed results for the 148 economies covered by the study and the 54 indicators composing the NRI. To complement the analysis of the results, Box 1 presents a classification of countries based on their NRI 2014 scores and the change rate of this Index over a two-year period; Box 2 assesses the nature of the digital divide in Europe; and Box 3 discusses the challenges large emerging economies must overcome if they are to keep moving forward in integrating ICTs into more robust innovation ecosystems that could help them transition from what appears to be a mid-life crisis toward a knowledge-based society. Finally, Appendix A of Chapter 1.1 details the structure of the NRI and describes the method of calculation.

Top 10

The top 10 spots continue to be dominated by Northern European economies, the Asian Tigers, and some of the most advanced Western economies. Three **Nordic economies**—Finland, Sweden, and Norway—lead the rankings and are positioned among the top 5. Denmark and Iceland, the remaining two Nordic economies, also perform strongly, and despite small slips this year they feature among the top 20. Overall, their performance in terms of ICT readiness, with excellent digital infrastructures and robust innovation systems, allows them to score very highly both in ICT use—with almost universal Internet use, for example—and in innovation performances. The **Asian Tigers**—composed of Singapore, Hong Kong SAR, the Republic of Korea, and Taiwan (China)—also perform very strongly, all of them positioned at the forefront of the NRI and with Singapore, Hong Kong SAR, and Korea featuring among the top 10. All these economies continue to boast outstanding business and innovation environments that are consistently ranked among the most conducive to entrepreneurship in the world. Finally, the top 10 includes some of the **most advanced Western economies**—the Netherlands, Switzerland, the United States, and the United Kingdom—that have recognized the potential of ICTs to embark in a new economic and social revolution, and thus have substantially invested in developing their digital potential.

In evolutionary terms, this year the rankings remain very stable, with no movement in the top 6 and negligible changes in the rest, with the exception of the significant improvement by six positions of Hong Kong SAR, which climbs to 8th place.

For a second consecutive year, **Finland** tops the rankings with a strong performance across the board. It ranks 1st in the readiness subindex thanks to an outstanding digital ICT infrastructure—the best in the world—and 2nd in both the usage and impact subindexes, with more than 90 percent of its population using the Internet and high levels of technological and non-technological innovation. The country also comes in 3rd in the environment subindex, with a very robust innovation system. **Singapore** continues to follow closely in the rankings, remaining in 2nd place. With the best pro-business and pro-innovation environment worldwide, the city-state continues to obtain the top rank in terms of ICT impacts, notably on the social dimension. Supported by a government with a clear digital strategy that offers the best online services in the world, an ICT infrastructure that is relentlessly being improved over time (16th), and one of the highest quality educational systems in the world (3rd), notably in terms of math and science (1st), Singapore has become one of the most knowledge-intensive economies globally (2nd) and is an ICT-generation powerhouse. **Sweden** (3rd) maintains its position this year despite a slight improvement in its overall score, unable to regain the top position it held two editions ago. Overall, the very strong performance of Sweden reflects its world-class, affordable (11th) ICT infrastructure (3rd) and a stable and pro-business and innovation environment (15th), despite its high tax rate (123rd). These strengths result in outstanding uptake and use of ICTs by individuals (1st), businesses (3rd), and government (7th) and one of the highest technological and non-technological innovation performances in the

world (2nd), making Sweden a truly knowledge-based society.

The **United States** moves up two positions to 7th place, thanks to slight improvements in many areas of the Index. These include the country's already good business and innovation environment (7th) and improvements in its ICT infrastructure (4th), notably in terms of wider access to international Internet bandwidth per user. Overall, the country exhibits a robust uptake of ICTs by all major stakeholders—businesses (9th), government (11th), and individuals (18th)—who manage to leverage well one of the best and more affordable (20th) ICT infrastructures (4th). Coupled with a pro-business and pro-innovation environment (7th), these result in a strong innovation capacity (5th) and significant ICT-related economic impacts (9th). The ranking of the United States, the largest economy in the world, in the top 10 shows that fully leveraging ICTs is not dependent on small or medium-sized economies, but instead depends on undertaking the right investments and creating the right condition for it. Despite a drop of two places, the **United Kingdom** continues to exhibit a very strong performance in 9th position. As a service-based economy, the country early recognized the importance of ICTs to support its innovation and competitiveness performance. As a result, it has managed to build a well-developed ICT infrastructure (15th), exhibiting one of the highest population uptakes (8th) and a well-developed e-commerce (1st), which, coupled with a strong pro-business environment, has resulted in solid economic (14th) and social (9th) impacts.

Regional results

Europe has been at the forefront of developing a digital ecosystem as a key ingredient that fosters innovation and competitiveness. As a result, several European countries lead the NRI rankings, with six European economies—Finland, Sweden, the Netherlands, Norway, Switzerland, and the United Kingdom—in the top 10. In addition, in order to maximize the positive impacts of ICTs throughout the European Union and create synergies and positive spillover effects, the European Commission has developed its Digital Agenda as one of seven flagship initiatives under its growth strategy Europe 2020. Despite these efforts, important differences remain across European economies, with Southern and Central and Eastern European economies continuing to lag behind. A deeper analysis of the root causes of these differences shows that, in general, ICT infrastructure and individual uptake is more homogeneous across EU Member States. However, less favorable conditions for innovation and entrepreneurship across European countries result in starker disparities in terms of the economic impacts—for example, innovation performance—accruing from their use, which illustrates the changing nature of the digital divide in Europe and in the rest of the world. The digital divide should not be regarded only in terms of access to ICT infrastructure, but also in terms of the impacts that using ICTs can provide for the economy and society in general. Within the **Commonwealth of Independent States,** several countries improve their performances, reflecting the key importance and hopes they have placed on ICTs to diversify their economies and lead them toward more knowledge-intensive activities.

With three economies from the region in the top 10 of the NRI rankings and several countries showing improvement, **Asia and the Pacific** is very dynamic and active in developing its ICT agenda. Yet a significant digital divide persists between the most advanced economies—such as the Asian Tigers and Japan—and emerging economies and other trailing countries. Regardless of their position on the development ladder, however, all Asian economies have much to gain from increased networked readiness. It will allow populations of the least advanced among them to gain access to much-needed basic services, to improve government transparency and efficiency, and—for the most advanced—it will contribute to boosting their innovation capacity and allow them to attain higher levels of competitiveness.

Improving the connectivity of **Latin America and the Caribbean** continues to represent one of the region's main challenges despite the recent efforts of many countries to develop and update their ICT infrastructures. Countries such as Chile, Panama, Uruguay, and Colombia have made significant progress in developing and ensuring more and better access to ICT infrastructure, ensuring higher ICT usage across stakeholders. However, persistent weaknesses in the broader innovation system hinder the overall capacity of the region to fully leverage ICTs to foster its competitiveness potential, highlighting the rise of the new digital divide—that is, the divide between countries that are achieving positive economic and social impacts related to the use of ICTs and those that are not.

Sub-Saharan Africa slowly continues to develop its ICT infrastructure, especially by expanding the share of the population covered by, and having access to, mobile telephony and by expanding the number of Internet users, which in some countries—such as South Africa—has almost doubled. These improvements have led to many important innovations that provide more and better services that were previously unavailable, such as financial services. Notwithstanding this progress, the region overall continues to suffer from a relatively poor ICT infrastructure, which remains costly to access, although some notable exceptions exist. More importantly, severe weaknesses persist in the region's business and innovation ecosystems, which result in very low positive economic and social impacts. Addressing these weaknesses, not only by developing a more solid ICT infrastructure but also by improving the framework conditions for innovation and entrepreneurship, will be

crucial to avoid the emergence of a new digital divide that will be evident in a disparity of the economic and social impacts associated with what has been called the digital revolution.

As in previous years, the **Middle East and North Africa** depicts a highly diversified outlook in terms of the capacity of countries to leverage ICTs to boost competitiveness and well-being. On the one hand, Israel and several Gulf Cooperation Council states have continued their efforts to improve ICT uptake and integrate ICTs better in more robust innovation ecosystems in order to obtain higher returns. On the other hand, many countries in North Africa continue to lag behind and suffer from important weaknesses in their framework conditions and overall innovation capacity that prevent them from fully leveraging ICTs and obtaining higher returns.

The Internet of Everything: How the Network Unleashes the Benefits of Big Data

Chapter 1.2, contributed by Robert Pepper and John Garrity from Cisco Systems, details how Internet protocol (IP) networks underpin the concept of the Internet of Everything (IoE) and explores how IP networks accelerate big data's transformational impact on individuals, businesses, and governments around the world.

As exabytes of new data are created daily, a rising share of this data growth is flowing over IP networks as more people, places, and things connect to the IoE. Proprietary networks are increasingly migrating to IP, facilitating the growth of big data, and networks are fast becoming the key link among data generation, analysis, processing, and utilization.

The authors highlight four major trends driving data growth over IP networks and detail how networks are central to maximizing analytical value from the data deluge. The chapter identifies critical technology and public policy challenges that could accelerate, or encumber, the full impact of big data and the IoE including standards and interoperability, privacy and security, spectrum and bandwidth constraints, cross-border data traffic, legacy regulatory models, reliability, scaling, and electrical power.

Big Data Maturity: An Action Plan for Policymakers and Executives

In Chapter 1.3, Bahjat El-Darwiche, Volkmar Koch, David Meer, Ramez T. Shehadi, and Walid Tohme of Booz & Company argue that big data has the potential to improve or transform existing business operations and reshape entire economic sectors. Big data can pave the way for disruptive, entrepreneurial companies and allow new industries to emerge. The technological aspect is important, but technology alone is insufficient to allow big data to show its full potential and to prevent companies from feeling swamped by this information. What matters is to reshape internal decision-making culture so that executives base their judgments on data rather than hunches. Research already indicates that companies that have managed this are more likely to be productive and profitable than their competition.

Organizations need to understand where they are in terms of big data maturity, an approach that allows them to assess progress and identify necessary initiatives. Judging maturity requires looking at environment readiness, determining how far governments have provided the necessary legal and regulatory frameworks and ICT infrastructure; considering an organization's internal capabilities and how ready it is to implement big data initiatives; and looking also at the many and more complicated methods for using big data, which can mean simple efficiency gains or revamping a business model. The ultimate maturity level involves transforming the business model to become data-driven, which requires significant investment over many years.

Policymakers should pay particular attention to environment readiness. They should present citizens with a compelling case for the benefits of big data. This means addressing privacy concerns and seeking to harmonize regulations around data privacy globally. Policymakers should establish an environment that facilitates the business viability of the big data sector (such as data, service, or IT system providers), and they should take educational measures to address the shortage of big data specialists. As big data becomes ubiquitous in public and private organizations, its use will become a source of national and corporate competitive advantage.

Balancing the Risks and Rewards of Data-Driven Public Policy

Alex "Sandy" Pentland from the Massachusetts Institute of Technology (MIT) highlights in Chapter 1.4 that we are entering a big data world, where governance is far more driven by data than it has been in the past. Basic to the success of a data-driven society is the protection of personal privacy and freedom. Discussions at the World Economic Forum have made substantial contributions to altering the privacy and data ownership standards around the world in order to give individuals unprecedented control over data that are about them, while at the same time providing for increased transparency and engagement in both the public and private spheres.

We still face the challenge that large organizations, and in particular governments, may be tempted to abuse the power of the data that they hold. To address this concern we need to establish best practices that are in the interests of both large organizations and individuals. This chapter suggests one path by which potential abuses of power can be limited, while at the same time providing greater security for organizations that use

big data. The key policy recommendations for all large organizations, commercial or government, are that:

1. Large data systems should store data in a distributed manner, separated by type (e.g., financial vs. health) and real-world categories (e.g., individual vs. corporate), managed by a department whose function is focused on those data, and with sharing permissions set and monitored by personnel from that department. Best practice would have the custodians of data be regional and use heterogeneous computer systems. With such safeguards in place, it is difficult to attack many different types of data at once, and it is more difficult to combine data types without authentic authorization.
2. Data sharing should always maintain provenance and permissions associated with data and support automatic, tamper-proof auditing. Best practice would share only answers to questions about the data (e.g., by use of pre-programmed SQL queries known as "Database Views") rather than the data themselves, whenever possible. This allows improved internal compliance and auditing, and helps minimize the risk of unauthorized information leakage.
3. Systems controlled by partner organizations, and not just a company's own systems, should be secure. External data sharing should occur only between data systems that have similar local control, permissions, provenance, and auditing, and should include the use of standardized legal agreements such as those employed in trust networks. Otherwise data can be siphoned off at either the data source or the end consumer, without the need for attacking central system directly.
4. The need for a secure data ecosystem extends to the private data of individuals and the proprietary data of partner companies. As a consequence, best practice for data flows to and from individual citizens and businesses is to require them to have secure personal data stores and be enrolled in a trust network data sharing agreement.
5. All entities should employ secure identity credentials at all times. Best practice is to base these credentials on biometric signatures.
6. Create an "open" data commons that is available to partners under a lightweight legal agreement, such as the trust network agreements. Open data can generate great value by allowing third parties to improve services.

Although these recommendations might at first glance seem cumbersome, they are for the most part easily implemented with the standard protocols found within modern computer databases and networks. In many cases, the use of distributed data stores and management are already part of current practice, and so the entire system will be simpler and cheaper to implement than a centralized solution: all that is really new is the careful use of provenance, permissions, and auditing within a legal or regulatory framework such as a trust network. Most importantly, these recommendations will result in a data ecosystem that is more secure and resilient, allowing us to safely reap the advantages of using big data to help set and monitor public policy.

Managing the Risks and Rewards of Big Data

In Chapter 1.5., Matt Quinn and Chris Taylor from TIBCO argue that expert handling of big data brings the reward of being able to react to world-changing events, both big and small, at an unprecedented rate and scope. Epidemics can be tracked and miracle drugs developed, for example, but at the same time, big data brings risks that require balancing those benefits against privacy concerns raised by the potentially unsettling correlation of personal information.

Organizations are awakening to the reality that an overwhelming amount of high-volume, wide-variety, and high-velocity data creates three key trends:

- Big data leverages previously untapped data sources to liberate information from places where it was previously hidden.
- Big data management requires automation wherever possible, because volume and complexity eliminate the ability of humans to intervene and reprogram processes in real time.
- Big data forces us to create adaptable, less fragile data systems because the sheer variety of structured and unstructured data breaks the old computational and transactional ways of writing logic.

These trends create two main challenges:

- Big data holds unseen patterns, which need to be visualized using analytics tools and techniques. Insights gained must be used at the right time, in the right context, and with the right approach.
- The challenge of systematically discovering, capturing, governing, and securing ever-larger amounts of data is much more complicated than the relatively simple problem of marshaling storage and computational resources.

These elements are the driving forces behind making use of big data in increasingly sophisticated ways. The chapter cites examples in healthcare, logistics, and retail where big data is being tackled with a systems approach that takes into consideration information streaming constantly as well as what is found in historical databases that cut through the mystique of

big data and get to the core of understanding big data's risks and rewards.

Rebalancing Socioeconomic Asymmetry in a Data-Driven Economy

Chapter 1.6, contributed by Peter Haynes of the Atlantic Council and M-H. Carolyn Nguyen at Microsoft, explains that an increasing amount of data is being generated by individuals who are handing potentially valuable information to commercial enterprises in exchange for "free" services. Moreover, they are doing this without realizing—or being recompensed for—their data's monetary value, and with little or no control over its immediate or future use. These socioeconomic asymmetries in the broad data ecosystem are a potential threat to the emerging data-driven economy, since they may reduce overall output as more and more economic activity is predicated on the use, exchange, and analytics of data. The authors argue the need for a data ecosystem based on fair value exchange and the ability of users to control the use of data related to them. The chapter also considers potential technology and policy approaches by which this might be achieved, and present the need for significant additional research and new thinking, in both technology and policy, to enable a sustainable data-driven economy.

Building Trust: The Role of Regulation in Unlocking the Value of Big Data

In Chapter 1.7, Scott Beardsley, Luís Enríquez, Ferry Grijpink, Sergio Sandoval, Steven Spittaels, and Malin Strandell-Jansson from McKinsey & Company highlight the expectation that big data will create great benefit for society, companies, and individuals in the coming years. For this to fully materialize, however, a number of factors must be in place. There must be robust high-speed Internet networks, an educated workforce, and consumer trust in the services, especially regarding the protection of personal data and privacy.

The increasing importance of protecting personal data and privacy is being recognized by countries and organizations across the world. There are, however, a range of diverging views about how to tackle the issue. These range from the light-touch approach of the United States, which leaves the issue mainly to the industry to solve, to the strict ex ante regulatory framework as advocated by the European Union.

No matter which approach is taken, a few issues remain unclear across the frameworks. These issues might hamper public trust in big data applications and companies and hinder the development of big data to its full potential. The issues of concern include how to define personal data, how to treat anonymous data, whether to allow the right to be forgotten, and the need to clarify the relevant jurisdictions and liabilities between parties.

The chapter outlines a few suggestions for regulators and companies about how to tackle these issues, and suggests that regulators should work closely with industry stakeholders and across regions to achieve technology-neutral high-level regulatory principles that last and promote industry self-regulation.

Companies should, after an initial assessment, implement necessary changes into their organization and cooperate with the regulators and industry stakeholders. Key, however, is to empower the customer. With clear and transparent privacy policies outlining practices, enabled services, and trade-offs, consumers are empowered to make their own choices while the trust of the industry is preserved.

From Big Data to Big Social and Economic Opportunities: Which Policies Will Lead to Leveraging Data-Driven Innovation's Potential?

Chapter 1.8, contributed by Pedro Less Andrade, Jess Hemerly, Gabriel Recalde, and Patrick Ryan at Google, focuses on the social and economic value of data, but from the point of view of use and purpose rather than volume. As it has become axiomatic that more data are produced every year, commentators have been driven to call this revolution the "age of big data." However, what is commonly known as "big data" is not a new concept: the use of data to build successful products and services, optimize business processes, and make more efficient data-based decisions already has an established history. Moreover, the term *big data* is ambiguous: the main features of big data (quantity, speed, variety) are technical properties that depend not on the data themselves but on the evolution of computing, storage, and processing technologies. What is important about big data is not its volume but how it may contribute to innovation and therefore be used to create value. This is why this chapter uses data-driven innovation to frame the discussion.

High-value solutions that may not have quantifiable economic value are being developed using data, and many sectors, from businesses to governments, benefit from data-driven innovation. Apart from producing and using data for better policymaking processes, the public sector can also play its part in promoting and fostering data-driven innovation and growth throughout economies by (1) making public data accessible through open data formats, (2) promoting balanced legislation, and (3) supporting education that focuses on data science skills.

Making Big Data Something More than the "Next Big Thing"

In Chapter 1.9., Anant Gupta, Chief Executive Officer at HCL Technologies Ltd, argues that big data analytics is not a passing fad. It will be a central means of creating value for the organization of tomorrow—almost literally, tomorrow. It represents a major change in the way that

businesses and other organizations will operate, and using it successfully will require a new mind-set and new capabilities. Given that, many organizations are struggling to even know where to start in becoming big-data competent. A step-by-step approach can make the transition seem less daunting and minimize the stumbles that are bound to occur along the way.

PARTS 2 AND 3: COUNTRY/ECONOMY PROFILES AND DATA PRESENTATION

Parts 2 and 3 of the *Report* feature comprehensive profiles for each of the 148 economies covered this year as well as data tables for each of the 54 variables composing the NRI, with global rankings. Each part begins with a description of how to interpret the data provided.

Technical notes and sources, included at the end of Part 3, provide additional insight and information on the definitions and sources of specific quantitative non-Survey data variables included in the NRI computation this year.

NOTES

1 Alexander 1983.

2 See Lanier 2010; see also Kakutani 2010.

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The Networked Readiness Index Rankings

The Networked Readiness Index 2014

Rank	Country/Economy	Value	2013 rank (out of 144)
1	Finland	6.04	1
2	Singapore	5.97	2
3	Sweden	5.93	3
4	Netherlands	5.79	4
5	Norway	5.70	5
6	Switzerland	5.62	6
7	United States	5.61	9
8	Hong Kong SAR	5.60	14
9	United Kingdom	5.54	7
10	Korea, Rep.	5.54	11
11	Luxembourg	5.53	16
12	Germany	5.50	13
13	Denmark	5.50	8
14	Taiwan, China	5.47	10
15	Israel	5.42	15
16	Japan	5.41	21
17	Canada	5.41	12
18	Australia	5.40	18
19	Iceland	5.30	17
20	New Zealand	5.27	20
21	Estonia	5.27	22
22	Austria	5.26	19
23	Qatar	5.22	23
24	United Arab Emirates	5.20	25
25	France	5.09	26
26	Ireland	5.07	27
27	Belgium	5.06	24
28	Malta	4.96	28
29	Bahrain	4.86	29
30	Malaysia	4.83	30
31	Lithuania	4.78	32
32	Saudi Arabia	4.78	31
33	Portugal	4.73	33
34	Spain	4.69	38
35	Chile	4.61	34
36	Slovenia	4.60	37
37	Cyprus	4.60	35
38	Kazakhstan	4.58	43
39	Latvia	4.58	41
40	Oman	4.56	40
41	Puerto Rico	4.54	36
42	Czech Republic	4.49	42
43	Panama	4.36	46
44	Jordan	4.36	47
45	Brunei Darussalam	4.34	57
46	Croatia	4.34	51
47	Hungary	4.32	44
48	Mauritius	4.31	55
49	Azerbaijan	4.31	56
50	Russian Federation	4.30	54
51	Turkey	4.30	45
52	Montenegro	4.27	48
53	Costa Rica	4.25	53
54	Poland	4.24	49
55	Barbados	4.22	39
56	Uruguay	4.22	52
57	Macedonia, FYR	4.19	67
58	Italy	4.18	50
59	Slovak Republic	4.12	61
60	Georgia	4.09	65
61	Mongolia	4.07	59
62	China	4.05	58
63	Colombia	4.05	66
64	Indonesia	4.04	76
65	Armenia	4.03	82
66	Seychelles	4.02	79
67	Thailand	4.01	74
68	Bosnia and Herzegovina	3.99	78
69	Brazil	3.98	60
70	South Africa	3.98	70
71	Trinidad and Tobago	3.97	72
72	Kuwait	3.96	62
73	Bulgaria	3.96	71
74	Greece	3.95	64
75	Romania	3.95	75
76	Sri Lanka	3.94	69
77	Moldova	3.89	77
78	Philippines	3.89	86
79	Mexico	3.89	63
80	Serbia	3.88	87
81	Ukraine	3.87	73
82	Ecuador	3.85	91
83	India	3.85	68
84	Vietnam	3.84	84
85	Rwanda	3.78	88
86	Jamaica	3.77	85
87	Tunisia	3.77	n/a
88	Guyana	3.77	100
89	Cape Verde	3.73	81
90	Peru	3.73	103
91	Egypt	3.71	80
92	Kenya	3.71	92
93	Dominican Republic	3.69	90
94	Bhutan	3.68	n/a
95	Albania	3.66	83
96	Ghana	3.65	95
97	Lebanon	3.64	94
98	El Salvador	3.63	93
99	Morocco	3.61	89
100	Argentina	3.53	99
101	Guatemala	3.52	102
102	Paraguay	3.47	104
103	Botswana	3.43	96
104	Iran, Islamic Rep.	3.42	101
105	Namibia	3.41	111
106	Venezuela	3.39	108
107	Gambia, The	3.38	98
108	Cambodia	3.36	106
109	Lao PDR	3.34	n/a
110	Zambia	3.34	115
111	Pakistan	3.33	105
112	Nigeria	3.31	113
113	Suriname	3.30	117
114	Senegal	3.30	107
115	Uganda	3.25	110
116	Honduras	3.24	109
117	Zimbabwe	3.24	116
118	Kyrgyz Republic	3.22	118
119	Bangladesh	3.21	114
120	Bolivia	3.21	119
121	Liberia	3.19	97
122	Côte d'Ivoire	3.14	120
123	Nepal	3.09	126
124	Nicaragua	3.08	125
125	Tanzania	3.04	127
126	Swaziland	3.00	136
127	Mali	3.00	122
128	Gabon	2.98	121
129	Algeria	2.98	131
130	Ethiopia	2.95	128
131	Cameroon	2.94	124
132	Malawi	2.90	129
133	Lesotho	2.88	138
134	Sierra Leone	2.85	143
135	Benin	2.82	123
136	Burkina Faso	2.78	130
137	Mozambique	2.77	133
138	Libya	2.75	132
139	Madagascar	2.74	137
140	Yemen	2.73	139
141	Timor-Leste	2.69	134
142	Mauritania	2.61	135
143	Haiti	2.52	141
144	Angola	2.52	n/a
145	Guinea	2.48	140
146	Myanmar	2.35	n/a
147	Burundi	2.31	144
148	Chad	2.22	142

Part 1

The Current Networked Readiness Landscape and Rewards and Risks of Big Data

CHAPTER 1.1

The Networked Readiness Index 2014: Benchmarking ICT Uptake in a World of Big Data

BEÑAT BILBAO-OSORIO, World Economic Forum
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BRUNO LANVIN, INSEAD

When *The Global Information Technology Report* (GITR) and the Networked Readiness Index (NRI) were created more than 13 years ago, the attention of decision makers was focused on how to develop strategies that would allow them to benefit from what *Time Magazine* had described as "the new economy": a new way of organizing and managing economic activity based on the new opportunities that the Internet provided for businesses.[1] At present, the world is slowly emerging from one of the worst financial and economic crises in decades, and policymakers, business leaders, and civil society are looking into new opportunities that can consolidate growth, generate new employment, and create business opportunities. Information and communication technologies (ICTs) continue to rank high on the list as one of the key sources of new opportunities to foster innovation and boost economic and social prosperity, for both advanced and emerging economies.

For more than 13 years, the NRI has provided decision makers with a useful conceptual framework to evaluate the impact of ICTs at a global level and to benchmark the ICT readiness and usage of their economies.

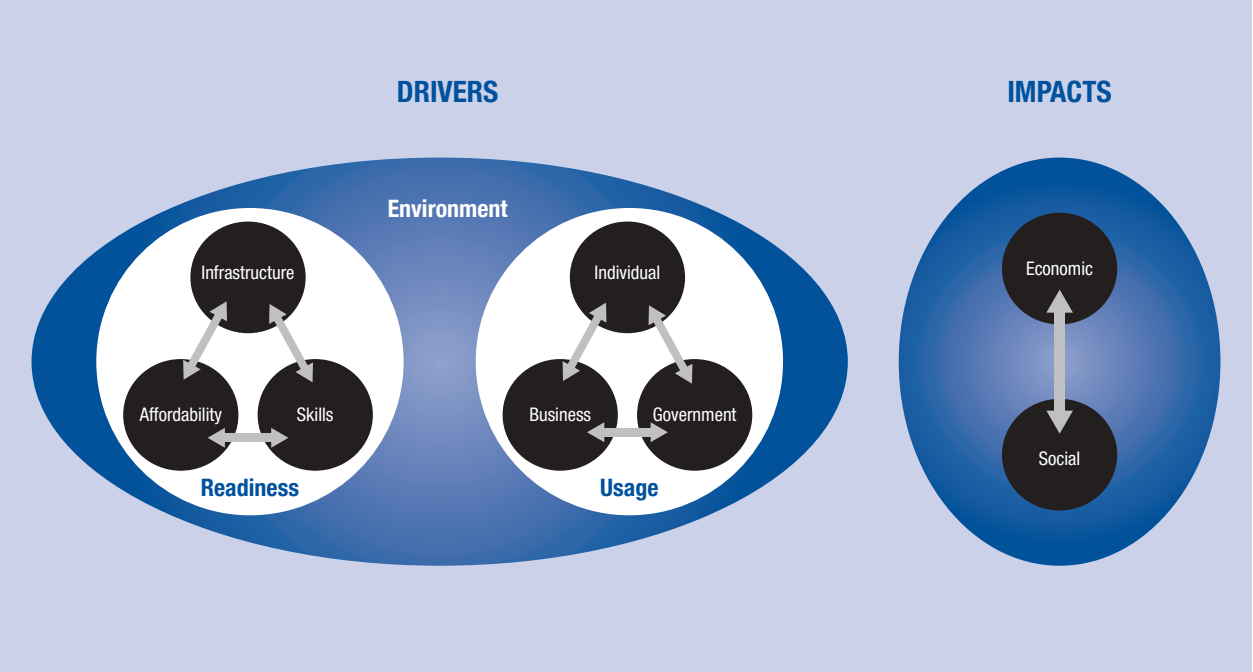
EXTRACTING VALUE FROM BIG DATA

Data have always had strategic value, but with the magnitude of data available today—and our capability to process them—they have become a new form of asset class. In a very real sense, data are now the equivalent of oil or gold. And today we are seeing a data boom rivaling the Texas oil boom of the 20th century and the San Francisco gold rush of the 1800s. It has spawned an entire support industry and has attracted a great deal of business press in recent years.

As explained in more detail in Chapter 1.3, this new asset class of big data is commonly described by what we call the "three Vs." Big data is high volume, high velocity, and includes a high variety of sources of information. Next to those three Vs we could add a fourth: value. This is what everyone is looking for, and this is why big data today gets so much attention. In the quest for value, the challenge facing us is how to reduce the complexity and unwieldiness of big data so that it becomes truly valuable.

Big data can take the form of structured data such as financial transactions or unstructured data such as photographs or blog posts. It can be crowd-sourced or obtained from proprietary data sources. Big data has been fueled by both technological advances (such as the spread of radio-frequency identification, or RFID, chips) and social trends (such as the widespread adoption of social media). Our collective discussions, comments, likes, dislikes, and networks of social connections are now all data, and their scale is massive. What did we search for? What did we read? Where did we go? With whom do we associate? What do we eat? What do

Figure 1: The Networked Readiness Index framework



we purchase? In short, almost any imaginable human interaction can be captured and studied within the realm of big data.

Big data has arrived. It is changing our lives and changing the way we do business. Some examples include the following:

- Google uses big data to predict the next wave of influenza.[2]
- IBM uses data to optimize traffic flow in the city of Stockholm,[3] and to get the best possible air quality.
- Dr. Jeffrey Brenner, a physician in New Jersey, uses medical billing data to map out hot spots where you can find his city's most complex and costly healthcare cases as part of a program to lower healthcare costs.[4]
- The National Center for Academic Transformation is using data mining to help understand which college students are more likely to succeed in which courses.[5]

But succeeding with big data requires more than just data. Data-based value creation requires the identification of patterns from which predictions can be inferred and decisions made. Businesses need to decide which data to use. The data each business owns might be as different as the businesses themselves; these data range from log files and GPS data to customer- or machine-to-machine data. Each business will need to select the data source it will use to create value. Moreover, creating this value will require the right way of dissecting and then analyzing those data with the right analytics. It will require knowing how to separate valuable information from hype. Chapter 1.7 provides guidelines for businesses to make this transition. To a large extent, mastering big data can also be compared to irrigation. It is not enough to "bring water" to where it can create fertility and value. Flooding can destroy crops and even drive precious nutrients away. Mastering water resources requires the delicate management of how much is needed and when, and often requires complex and interconnected systems of channels, levees, and regulation. Success with these resources is what made ancient Egypt a brilliant civilization and turned China into a unified country. The stakes are not dissimilar when applied to big data, but this is a resource that could benefit the entire planet instead of just one country.

For many, "data-driven" has become the new management philosophy. The Economist Intelligence Unit released survey data showing that approximately two-thirds of executives feel that big data will help find new market opportunities and make better decisions.[6] Nearly half of the surveyed respondents feel big data will increase competitiveness, and more than a third believe it will boost financial performance.

This world of big data has also become a source of concern. The consequences of big data for issues of privacy and other areas of society are not yet fully understood. Some prominent critics, such as Jaron Lanier,[7] call on us to be cautious about readily believing any result created by the "wisdom of the crowd."

Moreover, applications of big data in military intelligence have created a growing concern for privacy around the world.

Indeed, we are now living in a world where anything and everything can be measured. "Data" could become a new ideology. We are just at the beginning of a long journey where, with the proper principles and guidelines, we should be able to collect, measure, and analyze more and more information about everyone and everything in order to make better decisions, individually and collectively.

THE NETWORKED READINESS FRAMEWORK: A HOLISTIC APPROACH TO MEASURE ICT ACCESS AND IMPACTS

Because of the potential high returns that ICTs can provide in transforming a nation's economy and increasing its citizens' well-being, assessing ICT developments has been the object of much academic and policy attention over the past decade. Several organizations have exerted significant effort toward measuring and benchmarking ICT deployment and uptake, but few have tried as hard to assess the returns that ICTs can actually provide to both the economy and society. Although data are still scarce in terms of ICT impacts, policy interest in measuring ICTs has shifted from measuring ICT access to measuring ICT impacts.

In 2012, after two years of research and consultations with ICT practitioners, policy and industry experts, and academia, the Networked Readiness Index (NRI) introduced a new subindex on ICT impacts that aimed at holistically assessing the way that countries go about leveraging ICTs and benefiting from them in terms of enhanced competitiveness and well-being. This evolution ensures that the NRI framework remains at the forefront of ICT measurement. As one of the most authoritative assessments of its kind, it has been adopted by several governments as a valuable tool for informing their competitiveness and policy agendas.

The design of the framework for the calculation of the NRI (Figure 1) has been guided by five principles:

1. **Measuring the economic and social impacts of ICTs is crucial.** The NRI must include aspects of the way ICTs are transforming both the economy and society. In several economies, the ICT industry has become increasingly important and now accounts for a significant share of value-added and employment. In addition, ICTs interact closely with many other sectors, thus enabling innovations to accrue and affecting productivity. Moreover, the impacts of ICTs are also evident in the development of new skills that are important in knowledge-based, information-rich societies and that are crucial for employment. In society, ICTs allow citizens to participate more actively and steadily in social and political debates and make the government more accountable. They improve access to better and faster services, which, in turn, yield significant benefits.
2. **An enabling environment determines the capacity of an economy and society to benefit from the use of ICTs.** The success of a country in leveraging ICTs and achieving the desired economic and social benefits will depend on its overall environment—including market conditions, the regulatory framework, and innovation-prone conditions—to boost innovation and entrepreneurship.
3. **ICT readiness and usage remain key drivers and preconditions for obtaining any impacts.** Despite the increasing availability of ICTs, the question of access and usage remains important especially for developing countries, given their need to narrow the digital divide. Even within developed nations, the need to provide high-speed broadband to all segments of the population has acquired greater importance in recent years. Some features of the NRI are related to access and usage; these cover not only affordable ICT infrastructure but also digital resources, including software and skills. Moreover, ICT impacts can arise only if ICTs are widely used by all key actors—individuals, businesses, and governments. It is a society-wide effort. Those actors demonstrating better preparedness and greater interest are likely to use ICTs more and more effectively, contributing to a greater impact on competitiveness and development.
4. **All factors interact and co-evolve within an ICT ecosystem.** Those societies that can count on better-prepared actors and an enabling environment are more likely to benefit from higher rates of ICT use and more extensive impacts. At the same time, those societies that benefit from higher rates of ICT use and positive impacts will, in turn, be more likely to benefit from a push on the part of the different stakeholders to be better prepared and keep improving the framework conditions that will allow for more and stronger benefits to accrue. As a result, a virtuous circle starts, where improvements in one area affect and drive improvements in other areas. Conversely, lags in one particular factor also affect the evolution of the other factors.
5. **The framework should provide clear policy orientations and identify opportunities for public-private collaboration.** The NRI facilitates the identification of areas where policy intervention—through investment including public-private partnerships, smart regulation, or the provision of incentives—could boost the impacts of ICTs. This is important because the development and general uptake of ICTs depend on the capacity of a country to provide an institutional framework

with reliable and efficient rules and regulations; favorable business conditions for the founding and growth of new (social and commercial) enterprises; an innovation-prone environment, capable of developing and absorbing new knowledge; and an ICT-friendly government policy.

ELEMENTS OF THE NETWORKED READINESS INDEX

The networked readiness framework translates into the NRI, comprising four subindexes: these measure the environment for ICTs; the readiness of a society to use ICTs; the actual usage of all main stakeholders; and, finally, the impacts that ICTs generate in the economy and in society. The three first subindexes can be regarded as the drivers that establish the conditions for the results of the fourth subindex, ICT impacts. These four subindexes are divided into 10 pillars composed of 54 individual indicators in total, according to the following structure (see also Figure 2):

A. Environment subindex
1. Political and regulatory environment
2. Business and innovation environment

B. Readiness subindex
3. Infrastructure and digital content
4. Affordability
5. Skills

C. Usage subindex
6. Individual usage
7. Business usage
8. Government usage

D. Impact subindex
9. Economic impacts
10. Social impacts

The final NRI score is a simple average of the four composing subindex scores, while each subindex's score is a simple average of those of the composing pillars. In doing this, we assume that all NRI subindexes make a similar contribution to networked readiness. Appendix A includes detailed information on the composition and computation of the NRI 2014, while we briefly describe the different subindexes below.

Environment subindex

The environment subindex gauges the friendliness of a country's market and regulatory framework in supporting high levels of ICT uptake and the emergence of entrepreneurship and innovation-prone conditions. A supportive environment is necessary to maximize the potential impacts of ICTs in boosting competitiveness and well-being. It includes a total of 18 variables distributed into two pillars.

The *political and regulatory environment pillar* (composed of nine variables) assesses the extent to which the national legal framework facilitates ICT penetration and the safe development of business activities, taking into account general features of the regulatory environment (including the protection afforded to property rights, the independence of the judiciary, and the efficiency of the law-making process) as well as more ICT-specific dimensions (the passing of laws related to ICTs and software piracy rates).

The *business and innovation environment pillar* (nine variables) gauges the capacity of the business framework's conditions to boost entrepreneurship, taking into account dimensions related to the ease of doing business (including the presence of red tape and excessive fiscal charges). This pillar also measures the presence of conditions that allow innovation to flourish by including variables on the overall availability of technology, the demand conditions for innovative products (as proxied by the development of government procurement of advanced technology products), the availability of venture capital for financing innovation-related projects, and the presence of a skilled labor force.

Readiness subindex

The readiness subindex, with a total of 12 variables, measures the degree to which a society is prepared to make good use of an affordable ICT infrastructure and digital content.

The *infrastructure and digital content pillar* (five variables) captures the development of ICT infrastructure (including mobile network coverage, international Internet bandwidth, secure Internet servers, and electricity production) as well as the accessibility of digital content.

The *affordability pillar* (three variables) assesses the cost of accessing ICTs, either via mobile telephony or fixed broadband Internet, as well as the level of competition in the Internet and telephony sectors that determine this cost.

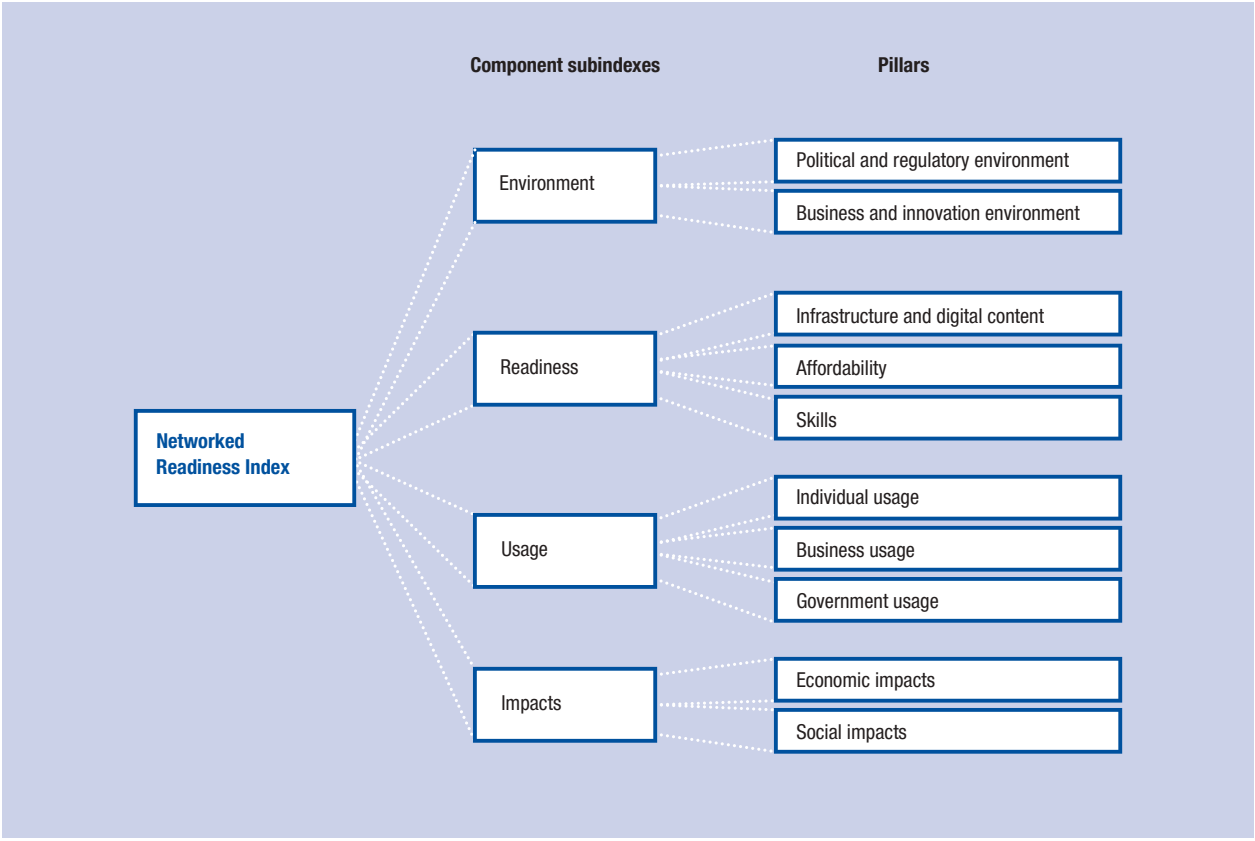
The *skills pillar* (four variables) gauges the ability of a society to make effective use of ICTs thanks to the existence of basic educational skills captured by the quality of the educational system, the level of adult literacy, and the rate of secondary education enrollment.

Usage subindex

The usage subindex assesses the individual efforts of the main social agents—that is, individuals, business, and government—to increase their capacity to use ICTs as well as their actual use in their day-to-day activities with other agents. It includes 16 variables.

The *individual usage pillar* (seven variables) measures ICT penetration and diffusion at the individual level, using indicators such as the number of mobile phone subscriptions, individuals using the Internet, households with a personal computer (PC), households with Internet access, both fixed and mobile broadband subscriptions, and the use of social networks.

Figure 2: The Networked Readiness Index structure



The *business usage pillar* (six variables) captures the extent of business Internet use as well as the efforts of the firms in an economy to integrate ICTs into an internal, technology-savvy, innovation-conducive environment that generates productivity gains. Consequently, this pillar measures the firm's technology absorption capacity as well as its overall capacity to innovate and the production of technology novelties measured by the number of Patent Cooperation Treaty (PCT) patent applications. It also measures the extent of staff training available, which indicates the extent to which management and employees are more capable of identifying and developing business innovations. As we did last year, we split the e-commerce variable to distinguish the business-to-business dimension from the business-to-consumer one, because some noticeable differences between the two dimensions exist in several countries.

The *government usage pillar* (three variables) provides insights into the importance that governments place on carrying out ICT policies for competitiveness and to enhance the well-being of their citizens, the effort they make to implement their visions for ICT development, and the number of government services they provide online.

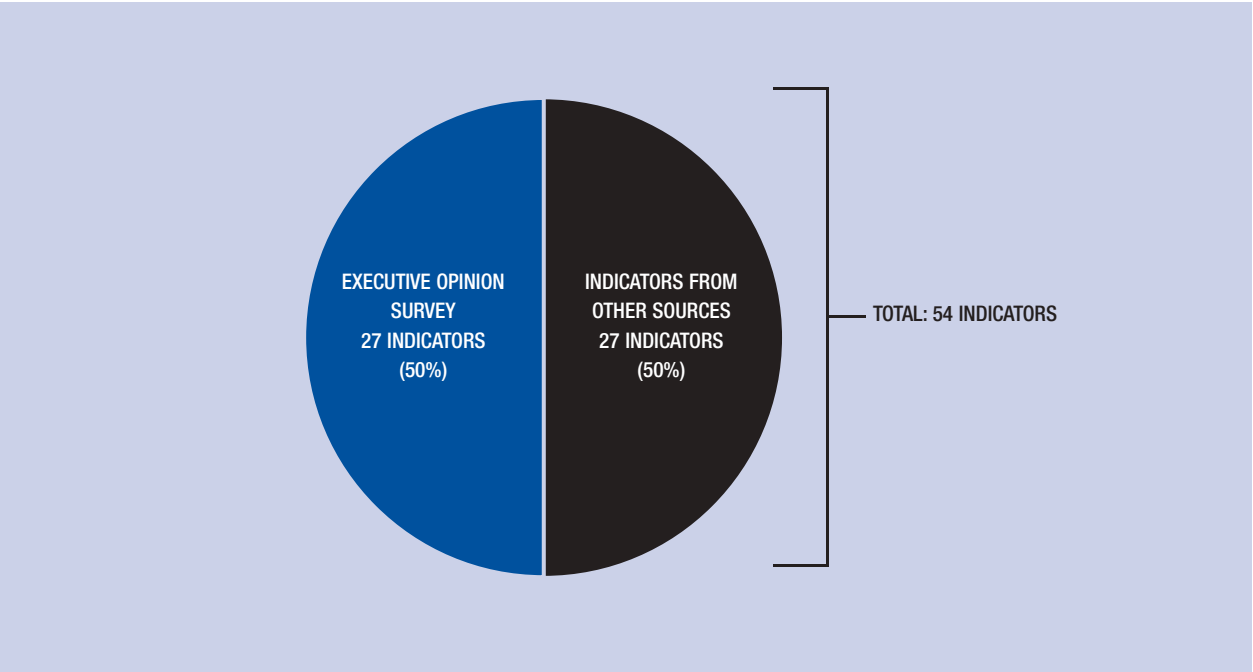
Impact subindex

The impact subindex gauges the broad economic and social impacts accruing from ICTs to boost competitiveness and well-being and that reflect the transformation toward an ICT- and technology-savvy economy and society. It includes a total of eight variables.

The *economic impacts pillar* (four variables) measures the effect of ICTs on competitiveness thanks to the generation of technological and non-technological innovations in the shape of patents, new products or processes, and novel organizational practices. In addition, it also measures the overall shift of an economy toward more knowledge-intensive activities.

The *social impacts pillar* (four variables) aims to assess the ICT-driven improvements in well-being that result from their impacts on the environment, education, energy consumption, health progress, or more-active civil participation. At the moment, because of data limitations, this pillar focuses on measuring the extent to which governments are becoming more efficient in the use of ICTs and provide increased online services to their citizens, and thus improving their e-participation. It also assesses the extent to which ICTs are present in education, as a proxy for the potential benefits that are associated with the use of ICTs in education.

Figure 3: Breakdown of indicators used in the Networked Readiness Index 2014 by data source



In general, measuring the impacts of ICTs is a complex task, and the development of rigorous quantitative data to do so is still in its infancy. As a result, many of the dimensions where ICTs are producing important impacts—especially when these impacts are not directly translated into commercial activities, as is the case for the environment and for health—cannot yet be covered. Therefore this subindex should be regarded as a work in progress that will evolve to accommodate new data on many of these dimensions as they become available.

COMPUTATION METHODOLOGY AND DATA

In order to capture as comprehensively as possible all relevant dimensions of societies' networked readiness, the NRI 2014 is composed of a mixture of quantitative and survey data, as shown in Figure 3.

Of the 54 variables composing the NRI this year, 27—or 50 percent—are quantitative data, collected primarily by international organizations such as International Telecommunication Union (ITU), the World Bank, and the United Nations. International sources ensure the validation and comparability of data across countries.

The remaining 27 variables capture aspects that are more qualitative in nature or for which internationally comparable quantitative data are not available for a large enough number of countries, but that nonetheless are crucial to fully measure national networked readiness. These data come from the Executive Opinion Survey (the Survey), which the Forum administers annually to over 15,000 business leaders in all economies included in the *Report*.[8] The Survey represents a unique source of insight into many critical aspects related to the enabling environment, such as the effectiveness of law-making bodies and the intensity of local competition; into ICT readiness, such as the quality of the educational system and the accessibility of digital content; into ICT usage, such as capacity to innovate and the importance of government vision for ICTs; and into impacts, such as the impact of ICTs on developing new products and services and improving access to basic services.

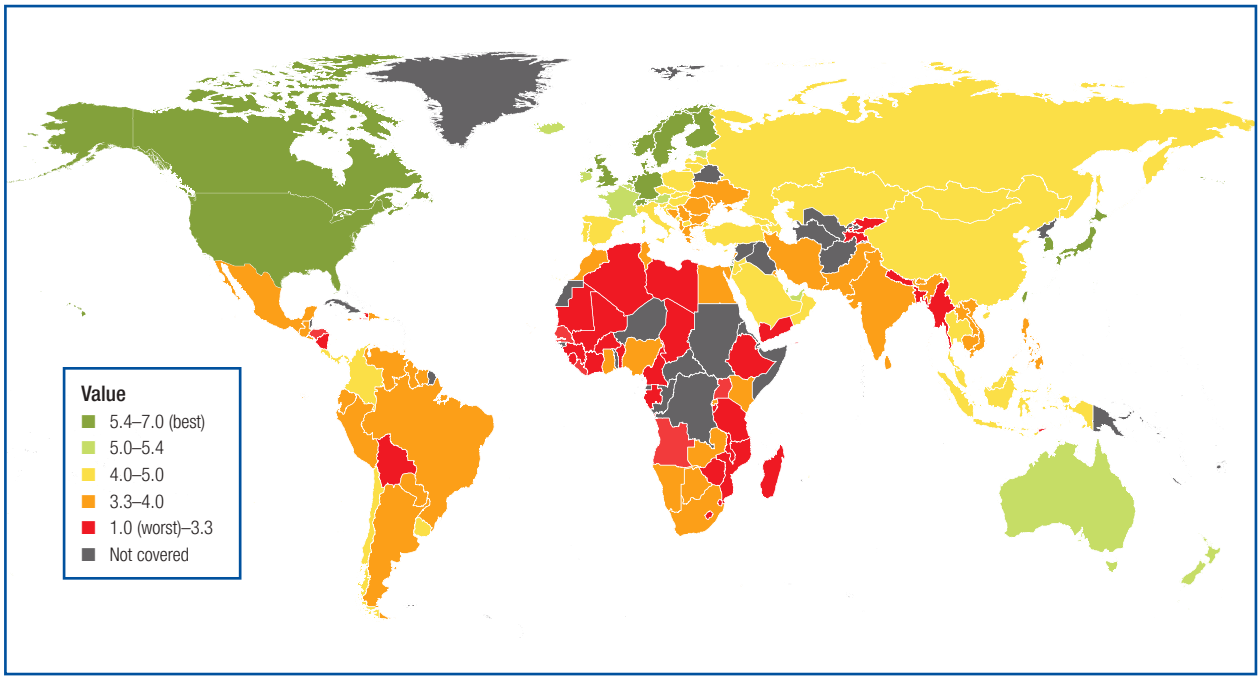
The NRI's coverage every year is determined by the Survey coverage and data availability for indicators obtained from other sources, mostly international organizations. This year the *Report* includes 148 economies, four more than the 2013 edition. The newly covered countries are Bhutan, Lao PDR, and Myanmar. We have also re-instated Angola and Tunisia into the Index, two countries that were not included in last year's edition. Tajikistan is not covered in the 2014 *Report* because Survey data could not be collected this year.

More details on variables included in the Index and their computation can be found in Appendix A and in the Technical Notes and Sources section at the end of the *Report*.

THE CURRENT NETWORKED READINESS LANDSCAPE: INSIGHTS FROM THE NRI 2014

This section provides an overview of the networked readiness landscape of the world as assessed by the

Figure 4: The Networked Readiness Index map



NRI 2014. It presents the results of the top 10 performers and selected countries by region, in the following order: Europe and the Commonwealth of Independent States; Asia and the Pacific; Latin America and the Caribbean, sub-Saharan Africa; and the Middle East and North Africa.

Tables 1 through 5 report the 2014 rankings for the overall NRI, its four subindexes, and its 10 pillars. In addition, the Country/Economy Profiles and Data Tables sections at the end of the *Report* present the detailed results for the 148 economies covered by the study and the 54 indicators composing the NRI. To complement the analysis of the results, Box 1 presents a classification of countries based on their NRI 2014 scores and the change rate of this Index over a two-year period; Box 2 assesses the nature of the digital divide in Europe; and Box 3 discusses the challenges large emerging economies must overcome if they are to keep moving forward in integrating ICTs into more robust innovation ecosystems that could help them transition from what appears to be a mid-life crisis toward a knowledge-based society. Figure 4 presents an intensity map of the world; economies are color-coded based on their NRI overall score measured on a 1-to-7 scale, with best- and worst-performing economies appearing in dark green and red, respectively. Finally, Appendix A of the present chapter details the structure of the NRI and describes the method of calculation.

TOP 10

As in previous years, the top 10 spots continue to be dominated by Northern European economies, the Asian Tigers, and some of the most advanced Western economies. Three **Nordic economies**—Finland, Sweden, and Norway—lead the rankings and are positioned among the top 5. Denmark and Iceland, the remaining two Nordic economies, also perform strongly, and despite small slips this year they feature among the top 20. Overall, their performance in terms of ICT readiness, with excellent digital infrastructures and robust innovation systems, allows them to score very highly both in ICT use—with almost universal Internet use, for example—and in innovation performances. The **Asian Tigers**—composed of Singapore, Hong Kong SAR, the Republic of Korea, and Taiwan (China)—also perform very strongly, all of them positioned at the forefront of the NRI and with Singapore, Hong Kong SAR, and the Republic of Korea featuring among the top 10. All these economies continue to boast outstanding business and innovation environments that are consistently ranked among the most conducive to entrepreneurship in the world. Finally, the top 10 includes some of the **most advanced Western economies**—the Netherlands, Switzerland, the United States, and the United Kingdom—that have recognized the potential of ICTs to embark in a new economic and social revolution, and thus have substantially invested in developing their digital potential.

In dynamic terms, this year the rankings remain very stable, with no movement in the top 6 and negligible

Table 1: The Networked Readiness Index 2014

Rank	Country/Economy	Value	2013 rank (out of 144)	Group*
1	Finland	6.04	1	ADV
2	Singapore	5.97	2	ADV
3	Sweden	5.93	3	ADV
4	Netherlands	5.79	4	ADV
5	Norway	5.70	5	ADV
6	Switzerland	5.62	6	ADV
7	United States	5.61	9	ADV
8	Hong Kong SAR	5.60	14	ADV
9	United Kingdom	5.54	7	ADV
10	Korea, Rep.	5.54	11	ADV
11	Luxembourg	5.53	16	ADV
12	Germany	5.50	13	ADV
13	Denmark	5.50	8	ADV
14	Taiwan, China	5.47	10	ADV
15	Israel	5.42	15	ADV
16	Japan	5.41	21	ADV
17	Canada	5.41	12	ADV
18	Australia	5.40	18	ADV
19	Iceland	5.30	17	ADV
20	New Zealand	5.27	20	ADV
21	Estonia	5.27	22	ADV
22	Austria	5.26	19	ADV
23	Qatar	5.22	23	MENA
24	United Arab Emirates	5.20	25	MENA
25	France	5.09	26	ADV
26	Ireland	5.07	27	ADV
27	Belgium	5.06	24	ADV
28	Malta	4.96	28	ADV
29	Bahrain	4.86	29	MENA
30	Malaysia	4.83	30	DEVASIA
31	Lithuania	4.78	32	CEE
32	Saudi Arabia	4.78	31	MENA
33	Portugal	4.73	33	ADV
34	Spain	4.69	38	ADV
35	Chile	4.61	34	LATAM
36	Slovenia	4.60	37	ADV
37	Cyprus	4.60	35	ADV
38	Kazakhstan	4.58	43	CIS
39	Latvia	4.58	41	CEE
40	Oman	4.56	40	MENA
41	Puerto Rico	4.54	36	ADV
42	Czech Republic	4.49	42	ADV
43	Panama	4.36	46	LATAM
44	Jordan	4.36	47	MENA
45	Brunei Darussalam	4.34	57	DEVASIA
46	Croatia	4.34	51	CEE
47	Hungary	4.32	44	CEE
48	Mauritius	4.31	55	SSA
49	Azerbaijan	4.31	56	CIS
50	Russian Federation	4.30	54	CIS
51	Turkey	4.30	45	CEE
52	Montenegro	4.27	48	CEE
53	Costa Rica	4.25	53	LATAM
54	Poland	4.24	49	CEE
55	Barbados	4.22	39	LATAM
56	Uruguay	4.22	52	LATAM
57	Macedonia, FYR	4.19	67	CEE
58	Italy	4.18	50	ADV
59	Slovak Republic	4.12	61	ADV
60	Georgia	4.09	65	CIS
61	Mongolia	4.07	59	CIS
62	China	4.05	58	DEVASIA
63	Colombia	4.05	66	LATAM
64	Indonesia	4.04	76	DEVASIA
65	Armenia	4.03	82	CIS
66	Seychelles	4.02	79	SSA
67	Thailand	4.01	74	DEVASIA
68	Bosnia and Herzegovina	3.99	78	CEE
69	Brazil	3.98	60	LATAM
70	South Africa	3.98	70	SSA
71	Trinidad and Tobago	3.97	72	LATAM
72	Kuwait	3.96	62	MENA
73	Bulgaria	3.96	71	CEE
74	Greece	3.95	64	ADV
75	Romania	3.95	75	CEE
76	Sri Lanka	3.94	69	DEVASIA
77	Moldova	3.89	77	CIS
78	Philippines	3.89	86	DEVASIA
79	Mexico	3.89	63	LATAM
80	Serbia	3.88	87	CEE
81	Ukraine	3.87	73	CIS
82	Ecuador	3.85	91	LATAM
83	India	3.85	68	DEVASIA
84	Vietnam	3.84	84	DEVASIA
85	Rwanda	3.78	88	SSA
86	Jamaica	3.77	85	LATAM
87	Tunisia	3.77	n/a	LATAM
88	Guyana	3.77	100	LATAM
89	Cape Verde	3.73	81	SSA
90	Peru	3.73	103	LATAM
91	Egypt	3.71	80	MENA
92	Kenya	3.71	92	SSA
93	Dominican Republic	3.69	90	LATAM
94	Bhutan	3.68	n/a	DEVASIA
95	Albania	3.66	83	CEE
96	Ghana	3.65	95	SSA
97	Lebanon	3.64	94	MENA
98	El Salvador	3.63	93	LATAM
99	Morocco	3.61	89	MENA
100	Argentina	3.53	99	LATAM
101	Guatemala	3.52	102	LATAM
102	Paraguay	3.47	104	LATAM
103	Botswana	3.43	96	SSA
104	Iran, Islamic Rep.	3.42	101	MENA
105	Namibia	3.41	111	SSA
106	Venezuela	3.39	108	LATAM
107	Gambia, The	3.38	98	SSA
108	Cambodia	3.36	106	DEVASIA
109	Lao PDR	3.34	n/a	DEVASIA
110	Zambia	3.34	115	SSA
111	Pakistan	3.33	105	MENA
112	Nigeria	3.31	113	SSA
113	Suriname	3.30	117	LATAM
114	Senegal	3.30	107	SSA
115	Uganda	3.25	110	SSA
116	Honduras	3.24	109	LATAM
117	Zimbabwe	3.24	116	SSA
118	Kyrgyz Republic	3.22	118	CIS
119	Bangladesh	3.21	114	DEVASIA
120	Bolivia	3.21	119	LATAM
121	Liberia	3.19	97	SSA
122	Côte d'Ivoire	3.14	120	SSA
123	Nepal	3.09	126	DEVASIA
124	Nicaragua	3.08	125	LATAM
125	Tanzania	3.04	127	SSA
126	Swaziland	3.00	136	SSA
127	Mali	3.00	122	SSA
128	Gabon	2.98	121	SSA
129	Algeria	2.98	131	MENA
130	Ethiopia	2.95	128	SSA
131	Cameroon	2.94	124	SSA
132	Malawi	2.90	129	SSA
133	Lesotho	2.88	138	SSA
134	Sierra Leone	2.85	143	SSA
135	Benin	2.82	123	SSA
136	Burkina Faso	2.78	130	SSA
137	Mozambique	2.77	133	SSA
138	Libya	2.75	132	MENA
139	Madagascar	2.74	137	SSA
140	Yemen	2.73	139	MENA
141	Timor-Leste	2.69	134	DEVASIA
142	Mauritania	2.61	135	MENA
143	Haiti	2.52	141	LATAM
144	Angola	2.52	n/a	SSA
145	Guinea	2.48	140	SSA
146	Myanmar	2.35	n/a	DEVASIA
147	Burundi	2.31	144	SSA
148	Chad	2.22	142	SSA

Note: Group classification follows the International Monetary Fund's classification (situation as of October 2013).
* Groups: ADV = Advanced economies; CIS = Commonwealth of Independent States and Mongolia; DEVASIA = Developing Asia; LATAM = Latin America and the Caribbean; MENA = Middle East and North Africa; SSA = Sub-Saharan Africa.

Table 2: Environment subindex and pillars

ENVIRONMENT SUBINDEX			Political and regulatory environment		Business and innovation environment	
Rank	Country/Economy	Score	Rank	Score	Rank	Score
1	Singapore	5.87	1	5.90	1	5.84
2	New Zealand	5.63	2	5.88	8	5.37
3	Finland	5.62	3	5.86	9	5.37
4	Hong Kong SAR	5.56	11	5.40	2	5.72
5	United Kingdom	5.50	5	5.66	10	5.33
6	Netherlands	5.48	8	5.53	5	5.44
7	Norway	5.46	7	5.54	6	5.38
8	Sweden	5.45	6	5.63	15	5.26
9	Switzerland	5.41	9	5.51	12	5.31
10	Canada	5.39	12	5.31	3	5.46
11	Luxembourg	5.31	4	5.73	29	4.90
12	Ireland	5.27	13	5.29	16	5.25
13	Qatar	5.23	14	5.23	17	5.23
14	Australia	5.20	15	5.23	21	5.17
15	United States	5.19	22	5.00	7	5.38
16	Denmark	5.19	19	5.16	18	5.21
17	Germany	5.14	10	5.41	31	4.87
18	United Arab Emirates	5.10	24	4.91	13	5.28
19	Belgium	5.08	21	5.01	22	5.14
20	Iceland	5.01	27	4.81	19	5.21
21	Japan	4.99	16	5.23	40	4.75
22	Israel	4.97	28	4.67	14	5.27
23	Austria	4.97	18	5.19	39	4.75
24	Malaysia	4.95	25	4.84	24	5.07
25	Taiwan, China	4.94	34	4.43	4	5.45
26	Estonia	4.88	26	4.83	28	4.93
27	Saudi Arabia	4.86	31	4.59	23	5.12
28	Rwanda	4.83	17	5.22	55	4.45
29	Chile	4.83	38	4.34	11	5.32
30	France	4.82	23	4.97	47	4.67
31	South Africa	4.76	20	5.05	53	4.48
32	Puerto Rico	4.75	29	4.64	33	4.86
33	Oman	4.69	32	4.54	36	4.84
34	Korea, Rep.	4.68	42	4.18	20	5.19
35	Portugal	4.63	39	4.26	25	5.00
36	Malta	4.62	30	4.63	49	4.62
37	Mauritius	4.61	33	4.48	43	4.75
38	Barbados	4.58	35	4.42	42	4.75
39	Cyprus	4.57	45	4.16	26	4.98
40	Bahrain	4.52	48	4.07	27	4.96
41	Jordan	4.45	44	4.16	41	4.75
42	Latvia	4.44	53	4.01	32	4.86
43	Lithuania	4.41	52	4.02	37	4.79
44	Turkey	4.38	55	4.00	38	4.77
45	Spain	4.31	47	4.09	51	4.54
46	Panama	4.31	62	3.76	35	4.85
47	Slovenia	4.28	72	3.66	30	4.89
48	Ghana	4.23	41	4.19	66	4.28
49	Czech Republic	4.23	51	4.05	60	4.41
50	Hungary	4.22	54	4.00	56	4.44
51	Uruguay	4.21	57	3.96	54	4.46
52	Montenegro	4.21	80	3.56	34	4.86
53	Macedonia, FYR	4.21	67	3.74	46	4.67
54	Brunei Darussalam	4.20	46	4.15	69	4.25
55	Poland	4.12	65	3.75	52	4.49
56	Thailand	4.12	79	3.56	45	4.69
57	Kazakhstan	4.11	61	3.80	58	4.42
58	Croatia	4.10	88	3.51	44	4.69
59	Namibia	4.10	37	4.38	112	3.81
60	Zambia	4.07	59	3.82	63	4.33
61	Botswana	4.05	40	4.26	107	3.84
62	Seychelles	4.05	49	4.07	90	4.02
63	Indonesia	4.04	68	3.71	62	4.36
64	Costa Rica	4.00	63	3.76	70	4.24
65	Guyana	4.00	64	3.76	71	4.23
66	Lao PDR	3.99	50	4.06	97	3.92
67	Jamaica	3.96	60	3.82	80	4.10
68	Gambia, The	3.95	36	4.39	125	3.50
69	Cape Verde	3.94	58	3.91	93	3.98
70	Azerbaijan	3.94	66	3.75	77	4.13
71	Bulgaria	3.94	105	3.29	50	4.59
72	Mongolia	3.91	98	3.39	57	4.43
73	Georgia	3.91	97	3.40	59	4.42
74	Slovak Republic	3.90	83	3.55	68	4.25
75	Mexico	3.88	70	3.68	85	4.07
76	Bhutan	3.87	43	4.17	123	3.57
77	China	3.87	56	3.97	115	3.76
78	Kuwait	3.85	75	3.61	81	4.09
79	Sri Lanka	3.85	74	3.62	82	4.08
80	Bosnia and Herzegovina	3.83	76	3.59	83	4.08
81	Ecuador	3.81	89	3.51	78	4.12
82	Liberia	3.80	92	3.45	75	4.15
83	Armenia	3.80	104	3.32	67	4.28
84	Morocco	3.79	81	3.56	88	4.03
85	Romania	3.79	101	3.38	72	4.20
86	Iran, Islamic Rep.	3.79	86	3.53	86	4.04
87	Russian Federation	3.78	100	3.39	73	4.17
88	Italy	3.77	99	3.39	76	4.15
89	Greece	3.76	114	3.20	64	4.32
90	Philippines	3.76	87	3.51	92	4.01
91	India	3.76	73	3.64	103	3.87
92	Kenya	3.75	71	3.67	110	3.83
93	Peru	3.75	119	3.10	61	4.39
94	Trinidad and Tobago	3.73	93	3.45	91	4.01
95	Albania	3.72	117	3.14	65	4.31
96	Vietnam	3.68	91	3.47	100	3.88
97	Dominican Republic	3.68	110	3.24	79	4.12
98	Cambodia	3.66	95	3.43	98	3.90
99	Lesotho	3.66	90	3.48	108	3.84
100	Senegal	3.64	106	3.26	89	4.02
101	Colombia	3.64	96	3.41	104	3.87
102	Tunisia	3.64	94	3.44	109	3.83
103	Lebanon	3.63	142	2.62	48	4.63
104	Uganda	3.59	77	3.57	121	3.61
105	Guatemala	3.59	123	3.02	74	4.16
106	Serbia	3.58	118	3.11	87	4.04
107	Malawi	3.57	69	3.70	130	3.43
108	Sierra Leone	3.55	82	3.55	124	3.55
109	Nigeria	3.54	112	3.23	106	3.85
110	El Salvador	3.53	121	3.10	95	3.96
111	Côte d'Ivoire	3.52	116	3.16	102	3.87
112	Ethiopia	3.50	102	3.37	120	3.64
113	Swaziland	3.49	84	3.55	129	3.44
114	Ukraine	3.48	130	2.89	84	4.08
115	Tanzania	3.47	85	3.54	132	3.39
116	Brazil	3.45	78	3.57	135	3.33
117	Mali	3.44	111	3.23	119	3.65
118	Pakistan	3.44	124	3.00	101	3.88
119	Egypt	3.44	115	3.18	117	3.69
120	Madagascar	3.43	129	2.90	94	3.97
121	Moldova	3.42	126	2.98	105	3.85
122	Kyrgyz Republic	3.39	131	2.89	99	3.89
123	Nepal	3.39	125	2.99	113	3.78
124	Mozambique	3.36	113	3.22	126	3.49
125	Cameroon	3.35	132	2.87	111	3.83
126	Burkina Faso	3.35	108	3.24	128	3.45
127	Benin	3.33	107	3.25	131	3.41
128	Nicaragua	3.32	103	3.32	136	3.31
129	Honduras	3.31	128	2.95	118	3.67
130	Paraguay	3.30	136	2.66	96	3.94
131	Bolivia	3.22	109	3.24	139	3.20
132	Bangladesh	3.21	138	2.65	114	3.77
133	Zimbabwe	3.20	122	3.06	133	3.35
134	Gabon	3.20	120	3.10	137	3.30
135	Argentina	3.19	135	2.78	122	3.61
136	Libya	3.17	141	2.64	116	3.69
137	Suriname	3.16	134	2.84	127	3.48
138	Timor-Leste	3.14	127	2.95	134	3.33
139	Yemen	2.94	143	2.58	138	3.30
140	Mauritania	2.91	133	2.86	143	2.95
141	Haiti	2.84	144	2.58	141	3.09
142	Guinea	2.77	139	2.65	144	2.89
143	Algeria	2.76	140	2.64	145	2.87
144	Burundi	2.73	146	2.43	142	3.03
145	Venezuela	2.72	148	2.30	140	3.15
146	Myanmar	2.68	137	2.66	146	2.71
147	Angola	2.59	145	2.52	147	2.65
148	Chad	2.40	147	2.43	148	2.36

Table 3: Readiness subindex and pillars

READINESS SUBINDEX			Infrastructure and digital content		Affordability		Skills	
Rank	Country/Economy	Score	Rank	Score	Rank	Score	Rank	Score
1	Finland	6.61	1	6.88	18	6.41	1	6.55
2	Iceland	6.44	2	6.88	13	6.44	13	5.99
3	Sweden	6.39	3	6.85	10	6.48	21	5.83
4	Norway	6.28	6	6.80	28	6.18	17	5.86
5	United States	6.27	4	6.83	21	6.36	32	5.62
6	Singapore	6.20	16	6.30	46	5.88	2	6.42
7	Taiwan, China	6.17	5	6.81	53	5.74	14	5.96
8	Germany	6.16	11	6.48	43	5.94	12	6.05
9	Australia	6.15	8	6.79	49	5.83	20	5.85
10	Switzerland	6.15	9	6.69	66	5.40	3	6.36
11	Austria	6.14	10	6.53	34	6.09	22	5.79
12	Hong Kong SAR	6.11	26	5.88	22	6.36	10	6.08
13	Canada	6.10	7	6.79	65	5.41	8	6.10
14	Denmark	6.06	20	6.15	29	6.17	18	5.85
15	Netherlands	5.97	14	6.42	69	5.37	7	6.12
16	Cyprus	5.95	28	5.80	39	6.00	11	6.05
17	Korea, Rep.	5.93	13	6.42	57	5.72	31	5.66
18	Luxembourg	5.91	17	6.29	56	5.73	27	5.73
19	Japan	5.84	21	6.09	54	5.73	29	5.69
20	Israel	5.76	29	5.71	35	6.05	39	5.51
21	United Kingdom	5.74	15	6.36	79	5.16	28	5.69
22	Estonia	5.73	25	5.94	61	5.51	25	5.76
23	Malta	5.73	18	6.28	90	4.99	16	5.90
24	Lithuania	5.69	45	4.85	12	6.45	23	5.78
25	Belgium	5.66	22	6.04	101	4.59	4	6.34
26	Ireland	5.65	19	6.17	98	4.68	9	6.09
27	France	5.64	27	5.80	72	5.27	19	5.85
28	Slovenia	5.60	24	5.95	82	5.12	26	5.74
29	Latvia	5.60	41	5.03	26	6.21	35	5.56
30	Spain	5.60	32	5.48	41	5.99	50	5.33
31	Kazakhstan	5.57	58	4.50	2	6.88	51	5.32
32	Bahrain	5.52	39	5.05	25	6.29	58	5.23
33	Italy	5.49	42	4.91	32	6.09	43	5.47
34	Ukraine	5.49	74	4.06	3	6.88	37	5.54
35	Czech Republic	5.49	23	6.04	84	5.09	49	5.33
36	Qatar	5.48	31	5.60	100	4.59	5	6.26
37	Russian Federation	5.46	47	4.81	14	6.44	64	5.13
38	United Arab Emirates	5.44	30	5.62	85	5.09	33	5.62
39	Poland	5.40	38	5.07	52	5.78	48	5.34
40	Georgia	5.39	59	4.50	4	6.82	78	4.85
41	Croatia	5.38	54	4.57	36	6.03	36	5.55
42	Turkey	5.35	48	4.78	17	6.43	80	4.85
43	Portugal	5.35	36	5.18	62	5.47	46	5.40
44	Mongolia	5.31	69	4.19	7	6.61	65	5.12
45	New Zealand	5.27	12	6.42	127	3.24	6	6.14
46	Bosnia and Herzegovina	5.25	63	4.38	30	6.12	57	5.25
47	Mauritius	5.22	76	3.88	11	6.47	52	5.32
48	Jordan	5.22	88	3.51	6	6.64	38	5.51
49	Azerbaijan	5.21	55	4.55	40	5.99	66	5.09
50	Costa Rica	5.21	92	3.43	15	6.44	24	5.76
51	Armenia	5.13	53	4.58	63	5.45	47	5.37
52	Romania	5.11	51	4.69	68	5.39	54	5.26
53	Serbia	5.11	49	4.77	67	5.39	63	5.15
54	Saudi Arabia	5.11	33	5.32	96	4.73	55	5.26
55	Moldova	5.10	60	4.44	31	6.12	84	4.74
56	Trinidad and Tobago	5.09	57	4.52	74	5.25	42	5.49
57	Oman	5.07	70	4.14	33	6.09	73	4.99
58	Panama	5.06	65	4.28	27	6.20	86	4.72
59	Malaysia	5.03	71	4.12	48	5.88	67	5.09
60	Chile	5.01	44	4.86	81	5.13	71	5.02
61	Montenegro	4.99	46	4.81	103	4.54	34	5.62
62	Greece	4.97	40	5.04	102	4.59	53	5.29
63	Thailand	4.97	73	4.07	47	5.88	74	4.95
64	Kuwait	4.95	52	4.65	76	5.18	70	5.03
65	Indonesia	4.92	85	3.58	37	6.03	61	5.16
66	Slovak Republic	4.91	62	4.40	71	5.31	72	5.01
67	Hungary	4.89	64	4.35	94	4.80	41	5.50
68	Uruguay	4.88	50	4.76	80	5.14	83	4.75
69	Sri Lanka	4.88	104	3.12	38	6.02	40	5.51
70	Colombia	4.85	80	3.74	44	5.93	76	4.89
71	Macedonia, FYR	4.85	61	4.43	88	5.04	68	5.07
72	Venezuela	4.78	91	3.44	20	6.39	94	4.50
73	China	4.76	86	3.53	60	5.57	59	5.18
74	Seychelles	4.76	43	4.91	113	3.92	44	5.44
75	Bulgaria	4.75	34	5.26	119	3.74	56	5.26
76	Brazil	4.71	56	4.53	91	4.97	91	4.62
77	Vietnam	4.65	121	2.69	8	6.59	88	4.68
78	Brunei Darussalam	4.65	37	5.15	129	3.12	30	5.69
79	Lebanon	4.63	77	3.86	99	4.62	45	5.41
80	Guyana	4.62	98	3.32	70	5.37	60	5.18
81	Philippines	4.60	89	3.51	75	5.24	69	5.07
82	Paraguay	4.60	72	4.10	50	5.81	105	3.89
83	Ecuador	4.59	75	3.94	92	4.89	75	4.94
84	Bhutan	4.58	67	4.22	45	5.89	114	3.63
85	India	4.57	119	2.72	1	7.00	101	4.00
86	Albania	4.57	90	3.49	87	5.07	62	5.16
87	Tunisia	4.55	83	3.59	73	5.25	81	4.80
88	Jamaica	4.52	79	3.81	89	5.03	87	4.71
89	Puerto Rico	4.46	66	4.24	n/a	n/a	90	4.68
90	Peru	4.43	95	3.37	59	5.65	99	4.27
91	Barbados	4.40	35	5.25	144	1.99	15	5.95
92	Suriname	4.40	101	3.25	86	5.08	77	4.86
93	Egypt	4.35	99	3.30	16	6.44	120	3.32
94	Mexico	4.34	81	3.72	93	4.89	95	4.42
95	Morocco	4.31	93	3.42	51	5.78	111	3.73
96	El Salvador	4.24	102	3.15	55	5.73	107	3.85
97	Zimbabwe	4.20	128	2.42	24	6.33	108	3.85
98	South Africa	4.17	68	4.21	112	3.97	97	4.32
99	Kenya	4.14	94	3.39	97	4.73	98	4.29
100	Argentina	4.13	78	3.86	121	3.69	79	4.85
101	Algeria	4.12	127	2.43	42	5.96	102	3.99
102	Cape Verde	4.09	107	3.06	106	4.45	82	4.76
103	Dominican Republic	4.05	87	3.52	95	4.75	106	3.88
104	Bangladesh	4.02	112	2.88	23	6.34	128	2.84
105	Pakistan	3.97	110	2.97	19	6.40	136	2.54
106	Kyrgyz Republic	3.95	96	3.35	116	3.83	89	4.68
107	Guatemala	3.92	100	3.29	78	5.17	122	3.31
108	Honduras	3.89	115	2.83	77	5.18	112	3.67
109	Ghana	3.89	124	2.50	64	5.41	110	3.75
110	Iran, Islamic Rep.	3.87	103	3.14	118	3.74	85	4.73
111	Nepal	3.82	141	1.65	9	6.49	121	3.32
112	Uganda	3.80	113	2.87	58	5.68	127	2.86
113	Cambodia	3.73	97	3.35	105	4.50	119	3.34
114	Liberia	3.70	145	1.57	5	6.78	131	2.75
115	Bolivia	3.58	114	2.83	126	3.36	93	4.54
116	Namibia	3.46	106	3.10	125	3.37	104	3.91
117	Gabon	3.34	132	2.28	109	4.09	113	3.66
118	Botswana	3.32	109	3.01	142	2.39	92	4.57
119	Nigeria	3.31	117	2.81	107	4.42	132	2.71
120	Yemen	3.31	129	2.39	83	5.12	138	2.41
121	Nicaragua	3.30	82	3.66	140	2.48	109	3.76
122	Libya	3.23	84	3.58	145	1.73	96	4.37
123	Tanzania	3.17	120	2.70	111	4.03	129	2.77
124	Côte d'Ivoire	3.15	105	3.11	120	3.70	133	2.65
125	Rwanda	3.14	108	3.05	128	3.13	123	3.25
126	Zambia	3.12	130	2.37	124	3.40	117	3.59
127	Senegal	3.08	116	2.83	117	3.78	134	2.64
128	Swaziland	3.07	118	2.79	143	2.28	100	4.14
129	Lao PDR	3.03	125	2.46	130	3.10	118	3.51
130	Lesotho	2.99	131	2.37	138	2.66	103	3.95
131	Gambia, The	2.85	123	2.60	137	2.75	124	3.20
132	Timor-Leste	2.80	111	2.97	133	2.83	135	2.61
133	Mauritania	2.78	139	1.72	104	4.53	145	2.08
134	Benin	2.76	122	2.69	134	2.82	130	2.76
135	Ethiopia	2.70	135	1.95	115	3.85	140	2.30
136	Malawi	2.70	126	2.43	139	2.62	125	3.03
137	Cameroon	2.65	143	1.58	136	2.77	116	3.60
138	Angola	2.63	146	1.55	110	4.07	141	2.26
139	Guinea	2.63	134	2.01	122	3.69	142	2.17
140	Haiti	2.61	142	1.63	108	4.09	143	2.11
141	Sierra Leone	2.59	138	1.85	114	3.88	146	2.03
142	Mozambique	2.31	137	1.86	132	3.06	147	2.00
143	Mali	2.29	140	1.69	135	2.78	139	2.41
144	Madagascar	2.29	144	1.57	141	2.42	126	2.88
145	Burundi	2.28	133	2.12	n/a	n/a	137	2.45
146	Chad	2.24	148	1.39	123	3.44	148	1.89
147	Burkina Faso	2.21	147	1.41	131	3.10	144	2.11
148	Myanmar	2.16	136	1.88	146	1.00	115	3.60

Table 4: Usage subindex and pillars

USAGE SUBINDEX			Individual usage		Business usage		Governent usage	
Rank	Country/Economy	Score	Rank	Score	Rank	Score	Rank	Score
1	Sweden	6.06	1	6.59	3	5.99	7	5.60
2	Finland	6.01	6	6.42	2	6.02	8	5.57
3	Korea, Rep.	5.89	9	6.32	10	5.48	3	5.85
4	Singapore	5.87	10	6.13	15	5.21	1	6.26
5	Netherlands	5.86	4	6.48	6	5.71	14	5.40
6	Norway	5.79	2	6.57	12	5.44	15	5.36
7	Denmark	5.75	3	6.57	7	5.66	26	5.01
8	Luxembourg	5.73	5	6.43	13	5.27	10	5.48
9	Japan	5.69	16	5.92	4	5.99	22	5.15
10	Switzerland	5.64	11	6.07	1	6.10	35	4.74
11	United States	5.60	18	5.76	9	5.56	11	5.47
12	United Kingdom	5.58	8	6.33	17	5.06	17	5.35
13	Germany	5.51	19	5.72	5	5.85	27	4.97
14	Israel	5.45	26	5.51	8	5.66	19	5.19
15	Hong Kong SAR	5.41	12	6.03	16	5.13	24	5.07
16	New Zealand	5.37	13	5.98	21	4.81	18	5.34
17	Taiwan, China	5.34	28	5.44	14	5.24	16	5.36
18	Qatar	5.33	21	5.69	26	4.53	4	5.77
19	Australia	5.28	15	5.92	24	4.75	21	5.17
20	Austria	5.27	20	5.71	11	5.44	36	4.65
21	United Arab Emirates	5.24	29	5.30	29	4.37	2	6.06
22	Estonia	5.22	17	5.84	28	4.38	12	5.45
23	France	5.16	22	5.65	20	4.88	28	4.96
24	Iceland	5.16	7	6.39	22	4.80	53	4.28
25	Bahrain	5.13	14	5.96	49	3.81	5	5.62
26	Canada	5.04	27	5.46	25	4.63	25	5.05
27	Belgium	5.02	25	5.52	18	5.05	42	4.47
28	Malta	5.01	24	5.55	32	4.09	13	5.40
29	Ireland	4.92	23	5.57	23	4.75	45	4.43
30	Malaysia	4.83	49	4.49	27	4.45	9	5.55
31	Saudi Arabia	4.78	44	4.67	34	4.04	6	5.62
32	Portugal	4.56	42	4.83	35	4.04	33	4.81
33	Spain	4.53	32	5.21	40	3.96	44	4.44
34	Lithuania	4.51	41	4.83	33	4.09	37	4.60
35	Slovenia	4.44	34	5.09	37	4.02	57	4.20
36	Puerto Rico	4.40	63	4.03	19	5.05	63	4.12
37	Oman	4.40	56	4.30	57	3.72	20	5.18
38	Kazakhstan	4.39	51	4.42	66	3.61	23	5.12
39	Chile	4.37	52	4.40	45	3.89	32	4.83
40	Czech Republic	4.36	30	5.26	31	4.10	96	3.72
41	Brunei Darussalam	4.36	50	4.47	56	3.73	30	4.86
42	Latvia	4.35	31	5.25	48	3.81	78	3.97
43	Barbados	4.30	33	5.11	53	3.77	72	4.01
44	Azerbaijan	4.24	61	4.19	52	3.78	34	4.77
45	Hungary	4.21	40	4.91	62	3.67	69	4.04
46	Croatia	4.18	39	4.99	81	3.46	65	4.08
47	Brazil	4.13	59	4.21	41	3.92	54	4.27
48	Cyprus	4.13	45	4.62	58	3.71	66	4.07
49	Slovak Republic	4.11	35	5.09	65	3.66	106	3.60
50	Panama	4.10	68	3.74	39	3.99	39	4.56
51	Italy	4.07	37	5.05	61	3.68	112	3.49
52	Montenegro	4.07	55	4.32	69	3.59	51	4.30
53	Russian Federation	4.06	46	4.61	84	3.45	61	4.13
54	Poland	4.06	36	5.08	75	3.52	108	3.57
55	Uruguay	4.05	48	4.55	86	3.43	59	4.16
56	Macedonia, FYR	4.03	53	4.38	101	3.31	47	4.41
57	Costa Rica	4.02	64	3.95	38	4.01	64	4.12
58	Kuwait	4.00	38	5.01	94	3.40	105	3.60
59	Jordan	3.96	67	3.79	47	3.81	52	4.28
60	Mauritius	3.95	66	3.86	64	3.66	48	4.34
61	China	3.91	80	3.27	44	3.89	38	4.58
62	Colombia	3.91	77	3.40	79	3.47	31	4.86
63	Turkey	3.90	69	3.69	46	3.87	60	4.14
64	Seychelles	3.90	65	3.87	55	3.76	68	4.06
65	Bulgaria	3.87	47	4.61	104	3.29	97	3.71
66	Trinidad and Tobago	3.86	60	4.20	87	3.43	80	3.96
67	Greece	3.83	43	4.74	102	3.30	117	3.45
68	Romania	3.76	62	4.17	98	3.34	90	3.77
69	Indonesia	3.75	95	2.90	36	4.03	49	4.31
70	South Africa	3.72	78	3.39	30	4.15	103	3.62
71	Mexico	3.72	89	3.07	70	3.59	40	4.50
72	Serbia	3.66	54	4.36	133	2.93	100	3.69
73	Armenia	3.65	74	3.52	82	3.45	76	3.98
74	Ecuador	3.63	83	3.18	71	3.59	62	4.13
75	Georgia	3.63	76	3.43	110	3.21	55	4.24
76	Philippines	3.63	91	2.94	43	3.89	67	4.06
77	Argentina	3.62	57	4.26	99	3.33	121	3.26
78	Vietnam	3.60	84	3.18	88	3.43	58	4.19
79	Bosnia and Herzegovina	3.59	70	3.67	92	3.42	99	3.69
80	Thailand	3.58	85	3.17	59	3.70	84	3.88
81	Sri Lanka	3.54	112	2.38	50	3.80	43	4.44
82	Morocco	3.53	72	3.63	111	3.21	92	3.76
83	Moldova	3.53	73	3.55	125	3.05	75	3.99
84	Tunisia	3.51	81	3.25	103	3.30	77	3.98
85	Mongolia	3.50	90	3.04	83	3.45	71	4.02
86	Kenya	3.49	113	2.30	54	3.76	46	4.41
87	Dominican Republic	3.49	93	2.92	67	3.60	81	3.95
88	Botswana	3.46	79	3.31	106	3.25	86	3.82
89	Egypt	3.45	71	3.66	112	3.21	113	3.49
90	Lebanon	3.45	58	4.23	116	3.19	136	2.93
91	India	3.45	121	2.08	51	3.78	41	4.48
92	Cape Verde	3.45	97	2.84	115	3.19	50	4.31
93	El Salvador	3.44	96	2.85	80	3.47	74	4.00
94	Jamaica	3.43	87	3.10	72	3.58	104	3.62
95	Albania	3.41	82	3.25	107	3.24	93	3.75
96	Guatemala	3.41	99	2.77	42	3.90	109	3.57
97	Rwanda	3.39	138	1.68	76	3.52	29	4.96
98	Peru	3.36	94	2.91	89	3.43	94	3.75
99	Gambia, The	3.35	120	2.12	60	3.69	56	4.24
100	Ghana	3.34	100	2.74	90	3.42	85	3.88
101	Ukraine	3.34	75	3.49	93	3.40	129	3.12
102	Guyana	3.34	103	2.54	63	3.66	87	3.81
103	Namibia	3.25	101	2.69	68	3.59	116	3.47
104	Zambia	3.17	123	2.04	77	3.51	79	3.97
105	Nigeria	3.17	110	2.42	73	3.55	111	3.54
106	Senegal	3.17	115	2.26	85	3.45	88	3.80
107	Cambodia	3.16	105	2.51	78	3.48	114	3.48
108	Venezuela	3.13	88	3.07	119	3.15	127	3.18
109	Paraguay	3.13	98	2.79	105	3.27	120	3.33
110	Bhutan	3.10	114	2.28	130	2.99	70	4.04
111	Mali	3.08	118	2.14	114	3.19	82	3.91
112	Lao PDR	3.07	129	1.87	74	3.54	89	3.80
113	Iran, Islamic Rep.	3.05	111	2.39	129	3.00	91	3.76
114	Suriname	3.04	86	3.11	108	3.23	141	2.78
115	Côte d'Ivoire	3.04	117	2.17	96	3.37	107	3.58
116	Bolivia	3.02	108	2.44	118	3.16	115	3.47
117	Honduras	2.95	106	2.46	91	3.42	133	2.98
118	Zimbabwe	2.93	107	2.45	109	3.22	128	3.14
119	Cameroon	2.93	130	1.78	95	3.38	102	3.64
120	Bangladesh	2.91	134	1.72	127	3.00	73	4.00
121	Pakistan	2.91	126	1.93	97	3.36	118	3.43
122	Gabon	2.90	109	2.43	126	3.02	122	3.26
123	Nicaragua	2.84	122	2.08	113	3.20	123	3.25
124	Tanzania	2.84	137	1.69	120	3.13	98	3.69
125	Uganda	2.83	140	1.63	122	3.12	95	3.75
126	Kyrgyz Republic	2.81	102	2.55	137	2.88	132	3.00
127	Burkina Faso	2.73	139	1.67	135	2.88	101	3.65
128	Swaziland	2.72	119	2.13	117	3.19	140	2.84
129	Madagascar	2.71	141	1.60	100	3.32	126	3.22
130	Ethiopia	2.71	146	1.46	141	2.77	83	3.90
131	Mozambique	2.70	144	1.50	124	3.06	110	3.55
132	Liberia	2.68	136	1.69	123	3.10	124	3.24
133	Nepal	2.66	125	1.96	132	2.95	130	3.07
134	Algeria	2.66	104	2.54	147	2.47	134	2.97
135	Sierra Leone	2.64	135	1.70	134	2.88	119	3.35
136	Malawi	2.63	142	1.55	121	3.12	125	3.23
137	Benin	2.63	124	1.98	128	3.00	137	2.90
138	Lesotho	2.57	127	1.92	136	2.88	135	2.93
139	Libya	2.56	92	2.92	144	2.63	148	2.13
140	Mauritania	2.54	116	2.24	139	2.85	146	2.53
141	Timor-Leste	2.48	128	1.90	142	2.66	138	2.89
142	Angola	2.48	133	1.74	143	2.64	131	3.07
143	Yemen	2.44	131	1.78	131	2.95	145	2.57
144	Guinea	2.39	145	1.47	138	2.85	139	2.84
145	Haiti	2.34	132	1.78	140	2.77	147	2.46
146	Myanmar	2.22	143	1.51	145	2.50	143	2.65
147	Chad	2.18	147	1.34	146	2.50	142	2.70
148	Burundi	2.12	148	1.30	148	2.42	144	2.64

Table 5: Impact subindex and pillars

IMPACT SUBINDEX			Economic impacts		Social impacts	
Rank	Country/Economy	Score	Rank	Score	Rank	Score
1	Singapore	5.93	6	5.63	1	6.24
2	Finland	5.91	1	6.04	7	5.78
3	Netherlands	5.85	5	5.63	3	6.06
4	Sweden	5.82	2	6.03	10	5.62
5	Korea, Rep.	5.67	7	5.25	2	6.09
6	Israel	5.52	4	5.64	14	5.40
7	Taiwan, China	5.43	12	5.08	6	5.79
8	United States	5.39	9	5.20	12	5.58
9	United Kingdom	5.36	14	5.01	9	5.72
10	Hong Kong SAR	5.32	13	5.03	11	5.62
11	Switzerland	5.30	3	5.64	26	4.96
12	Norway	5.29	15	5.00	13	5.58
13	Estonia	5.23	22	4.58	4	5.88
14	Germany	5.20	8	5.22	20	5.17
15	Luxembourg	5.17	10	5.16	19	5.17
16	Japan	5.12	11	5.12	23	5.13
17	Canada	5.10	17	4.87	16	5.33
18	United Arab Emirates	5.01	27	4.19	5	5.84
19	Denmark	4.99	16	4.94	24	5.05
20	Australia	4.95	23	4.57	15	5.33
21	Qatar	4.84	32	3.95	8	5.72
22	New Zealand	4.81	26	4.44	17	5.18
23	France	4.73	19	4.77	35	4.68
24	Austria	4.67	24	4.51	31	4.83
25	Iceland	4.61	25	4.51	34	4.72
26	Puerto Rico	4.56	21	4.66	38	4.46
27	Lithuania	4.53	28	4.11	27	4.96
28	Malaysia	4.51	30	4.01	25	5.00
29	Belgium	4.50	20	4.67	40	4.33
30	Malta	4.49	29	4.03	28	4.94
31	Ireland	4.43	18	4.83	55	4.03
32	Saudi Arabia	4.40	37	3.65	22	5.14
33	Portugal	4.36	34	3.87	30	4.85
34	Spain	4.30	31	3.97	36	4.63
35	Bahrain	4.26	63	3.35	18	5.17
36	Kazakhstan	4.26	60	3.38	21	5.15
37	Chile	4.23	43	3.55	29	4.91
38	Brunei Darussalam	4.15	51	3.48	32	4.82
39	Slovenia	4.07	33	3.92	43	4.22
40	Oman	4.07	56	3.41	33	4.73
41	Panama	3.99	46	3.49	37	4.48
42	Hungary	3.97	36	3.68	42	4.26
43	Latvia	3.94	35	3.71	45	4.17
44	Russian Federation	3.91	41	3.56	41	4.27
45	Czech Republic	3.87	38	3.63	47	4.12
46	Azerbaijan	3.85	42	3.55	46	4.15
47	Montenegro	3.81	39	3.60	56	4.02
48	Jordan	3.81	44	3.53	51	4.09
49	Colombia	3.79	75	3.16	39	4.42
50	Costa Rica	3.75	52	3.47	54	4.04
51	Rwanda	3.75	53	3.45	53	4.05
52	Cyprus	3.73	45	3.49	57	3.97
53	Uruguay	3.73	61	3.36	50	4.10
54	Croatia	3.69	40	3.56	66	3.83
55	Macedonia, FYR	3.68	65	3.31	52	4.06
56	China	3.67	81	3.11	44	4.22
57	Brazil	3.64	64	3.34	58	3.94
58	Barbados	3.62	57	3.40	64	3.84
59	Mexico	3.62	80	3.12	48	4.11
60	India	3.61	50	3.48	73	3.74
61	Egypt	3.61	59	3.38	65	3.83
62	Philippines	3.57	48	3.49	76	3.66
63	Mongolia	3.57	89	3.04	49	4.10
64	Dominican Republic	3.55	71	3.22	61	3.88
65	Turkey	3.55	68	3.27	67	3.83
66	Slovak Republic	3.54	54	3.44	78	3.63
67	Armenia	3.53	47	3.49	80	3.58
68	Moldova	3.52	76	3.16	60	3.89
69	Sri Lanka	3.47	66	3.30	77	3.64
70	Mauritius	3.47	70	3.25	74	3.69
71	Kenya	3.46	55	3.42	83	3.50
72	Indonesia	3.46	86	3.07	63	3.84
73	Cape Verde	3.45	83	3.09	69	3.81
74	Georgia	3.44	100	2.95	59	3.93
75	Vietnam	3.41	96	2.98	62	3.85
76	Tunisia	3.39	90	3.03	72	3.76
77	Seychelles	3.39	77	3.16	79	3.63
78	Poland	3.39	62	3.36	88	3.42
79	Gambia, The	3.39	67	3.27	84	3.50
80	Ecuador	3.38	95	2.99	71	3.78
81	Peru	3.37	84	3.08	75	3.67
82	Italy	3.37	58	3.40	94	3.34
83	Thailand	3.35	104	2.88	68	3.83
84	El Salvador	3.31	109	2.84	70	3.78
85	Senegal	3.29	82	3.10	86	3.48
86	Bulgaria	3.27	73	3.20	93	3.35
87	Bosnia and Herzegovina	3.27	88	3.04	85	3.49
88	Lao PDR	3.27	74	3.18	92	3.35
89	South Africa	3.25	49	3.48	113	3.02
90	Greece	3.24	91	3.03	87	3.45
91	Nigeria	3.23	72	3.20	99	3.25
92	Trinidad and Tobago	3.21	92	3.02	89	3.41
93	Serbia	3.19	93	3.00	90	3.38
94	Jamaica	3.18	78	3.13	100	3.24
95	Mali	3.18	69	3.25	109	3.10
96	Argentina	3.18	87	3.07	98	3.29
97	Bhutan	3.17	112	2.78	81	3.56
98	Ukraine	3.16	79	3.12	102	3.20
99	Guatemala	3.16	94	2.99	95	3.32
100	Romania	3.13	97	2.96	96	3.30
101	Ghana	3.12	85	3.08	106	3.17
102	Guyana	3.12	106	2.87	91	3.37
103	Kuwait	3.04	127	2.58	82	3.50
104	Bolivia	3.01	111	2.79	101	3.24
105	Pakistan	2.99	98	2.96	112	3.03
106	Zambia	2.99	113	2.78	104	3.20
107	Iran, Islamic Rep.	2.97	114	2.77	105	3.17
108	Albania	2.95	125	2.60	97	3.30
109	Venezuela	2.94	115	2.76	108	3.12
110	Botswana	2.90	120	2.68	107	3.12
111	Cambodia	2.90	117	2.70	110	3.10
112	Ethiopia	2.88	128	2.57	103	3.20
113	Nicaragua	2.87	122	2.65	111	3.08
114	Lebanon	2.87	101	2.92	121	2.81
115	Paraguay	2.86	99	2.95	125	2.78
116	Cameroon	2.85	103	2.88	123	2.81
117	Namibia	2.85	105	2.88	122	2.81
118	Burkina Faso	2.84	108	2.85	120	2.84
119	Côte d'Ivoire	2.84	102	2.92	127	2.76
120	Honduras	2.80	116	2.75	119	2.85
121	Morocco	2.79	123	2.64	115	2.94
122	Uganda	2.79	126	2.60	114	2.98
123	Mozambique	2.73	121	2.67	124	2.79
124	Swaziland	2.73	118	2.70	126	2.76
125	Malawi	2.72	110	2.79	131	2.64
126	Kyrgyz Republic	2.71	131	2.50	116	2.92
127	Bangladesh	2.71	130	2.50	118	2.91
128	Tanzania	2.68	132	2.45	117	2.91
129	Suriname	2.62	107	2.86	138	2.38
130	Sierra Leone	2.62	124	2.63	133	2.61
131	Zimbabwe	2.61	129	2.54	130	2.69
132	Benin	2.58	119	2.69	136	2.47
133	Liberia	2.57	134	2.43	128	2.71
134	Madagascar	2.52	135	2.42	132	2.61
135	Nepal	2.51	141	2.32	129	2.70
136	Gabon	2.49	136	2.41	134	2.58
137	Algeria	2.39	133	2.44	140	2.34
138	Angola	2.38	137	2.40	139	2.36
139	Timor-Leste	2.34	143	2.30	137	2.39
140	Myanmar	2.33	139	2.37	141	2.30
141	Lesotho	2.31	147	2.08	135	2.53
142	Haiti	2.30	138	2.39	143	2.22
143	Yemen	2.24	140	2.35	145	2.13
144	Mauritania	2.23	142	2.32	144	2.14
145	Guinea	2.15	148	2.04	142	2.27
146	Burundi	2.09	144	2.18	147	2.00
147	Chad	2.08	146	2.12	146	2.05
148	Libya	2.03	145	2.12	148	1.94

changes in the rest, with the exception of the significant improvement by six positions of Hong Kong SAR, which climbs to 8th place. Box 1 presents and analyzes the position and evolution of different economies in the rankings over the past two years, highlighting different dynamics in building and leveraging their digital ecosystems.

For a second consecutive year, **Finland** tops the rankings with a strong performance across the board. It ranks 1st in the readiness subindex thanks to an outstanding digital ICT infrastructure—the best in the world—and 2nd in both the usage and impact subindexes, with more than 90 percent of its population using the Internet and with high levels of technological and non-technological innovation. The country also comes in 3rd in the environment subindex, with a very robust innovation system. This positive digital landscape has been created over the years, as Finland decidedly started investing in building its ICT ecosystem in the mid-1990s as an answer to its financial and economic crisis at that time. Since then, the active role of all stakeholders—government, businesses, and individuals—has resulted in the positive outcome we see today.

As in past years, **Singapore** continues to follow closely in the rankings, remaining in 2nd place. With the best pro-business and pro-innovation environment worldwide, the city-state continues to obtain the top rank in terms of ICT impacts, notably on the social dimension. Supported by a government with a clear digital strategy that offers the best online services in the world, an ICT infrastructure that is relentlessly being improved over time (16th), and one of the highest quality educational systems in the world (3rd), notably in terms of math and science (1st), Singapore has become one of the most knowledge-intensive economies globally (2nd) and is an ICT-generation powerhouse (9th). Improving the already very high number of Internet users (29th) or households with a personal computer and Internet access (11th) to the level of some Nordic countries, coupled with reducing the cost of accessing fixed broadband Internet (now at 87th), would allow Singapore to lead the overall rankings.

Sweden (3rd) maintains its position this year despite a slight improvement in its overall score. Overall, the very strong performance of Sweden reflects its world-class, affordable (11th) ICT infrastructure (3rd) and a stable and pro-business and innovation environment (15th), despite its high tax rate (123rd). These strengths result in outstanding uptake and use of ICTs by individuals (1st), businesses (3rd), and government (7th) and one of the highest technological and non-technological innovation performances in the world (2nd), making Sweden a truly knowledge-based society.

The **Netherlands** retains its 4th position despite a slight decline in its score driven by a small drop in the economic impacts pillar, where it nevertheless ranks a very respectable 5th globally. The country, as a service-based economy, has quickly and skilfully recognized the importance of ICTs to boost its innovation and competitiveness potential; this is reflected in virtually all the indicators, where the country ranks among the best in the world. ICTs have permeated all stages of society in the Netherlands, with nearly all individuals having access to a computer (1st) with an Internet connection at home (3rd), a large number of government services are online (5th), and businesses use extensive e-commerce in their transactions with other businesses (11th) and with consumers (4th). These scores, coupled with an environment highly conducive to innovation and entrepreneurship, result in very high levels of ICT-based innovations and the highest citizen e-participation in the world (1st). Although the affordability (67th) of a well-developed ICT infrastructure and digital content (14th) still remains an unresolved issue, it does not seem to interfere in the capacity of the country to fully leverage ICTs to obtain meaningful economic (5th) and social (3rd) impacts.

Stable at 5th place, **Norway** continues to leverage ICTs effectively. With a well-developed and affordable (28th) ICT infrastructure (6th), ICT uptake is virtually universal among Norway's population: 95 percent are Internet users and more than 90 percent have access to a personal computer (5th) and Internet (4th) at home. In addition, the country benefits from a stable pro-business and innovation environment (6th) and a government that is aware of the importance of ICTs for the economic and social development of a geographically vast nation with a widely dispersed population. Despite these many assets, compared with its Nordic neighbors, Norway depicts poorer results in terms of technological innovation (12th), notably in the domain of ICTs (16th); improving the quality of the overall educational system (18th), notably in the area of math and science (47th), may represent part of the solution.

Switzerland revalidates its 6th position of the previous edition. The country benefits from very good, albeit expensive (66th) ICT infrastructure (9th) and a good educational system that provides the necessary skills to create a knowledge-based, technology-rich economy. Those assets, coupled with a stable political and regulatory environment (9th) and excellent conditions for innovation and entrepreneurship (12th), have resulted in outstanding uptake and use of ICTs by businesses (1st) in all their transactions and in their ability to foster innovation. In this process of digitization, the government appears to be lagging slightly behind (35th): government online services (32nd) continue to be relatively reduced compared with those of other countries of its economic and social level of development, which partially affects its overall social impacts (26th).

The **United States** moves up two positions to 7th place, thanks to slight improvements in many areas of the Index. These include the country's already

Box 1: Which countries are bridging the digital divide and which countries are not? An evolutionary analysis of the NRI results

The GITR series, through its Networked Readiness Index (NRI), depicts how countries leverage ICTs to boost competitiveness and well-being. A constant finding in the NRI analysis, and one that gets reflected in the overall rankings, is that developed economies continue to lead the way in creating robust and impactful digital ecosystems while many developing and emerging economies have remained comparatively stagnant. This stagnation persists despite some improvements to their ICT infrastructures—specifically, ensuring more and better mobile telephony access and services. As a result, there has been little progress in bridging the digital divide across nations. This lack of progress casts doubts about the capacity of developing and emerging economies to embrace the full potential that ICTs have to offer.

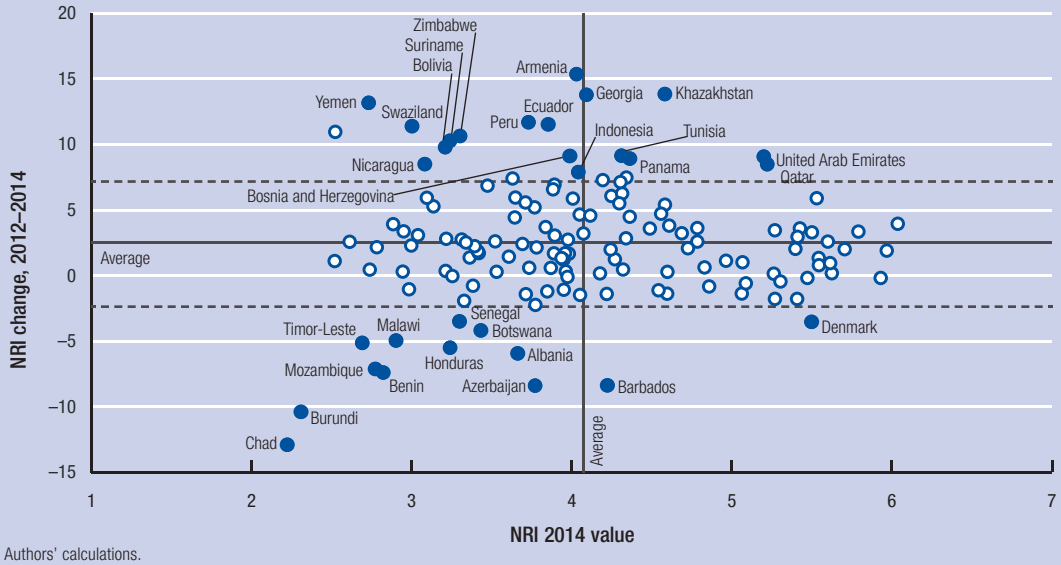
However, the NRI rankings reflect the situation only at a particular moment in time. They do not take into account the evolution that different countries experience over time.

Figure A presents the situation of each analyzed economy based on both its current NRI score and its NRI evolution over the past three years. The position of each economy is then determined according to whether it falls above or below the NRI average in 2014, and whether it falls above or below the average change in the NRI score over the past two editions. As a result, each country's position in the figure reflects its placement in relation to the sample average—that is, whether it has an above- or below-average ICT capacity. Each country's position also indicates whether it is growing above or below the sample average—that is, whether it is catching up or lagging behind in the long-term race of developing and leveraging its digital ecosystem. In addition, and in order to identify with more precision those countries that have experienced the starkest changes over time, the figure includes an upper and a lower band. These bands are calculated based on the standard deviation of the NRI change of the past two years; the upper band is the sample average change plus 1 standard deviation, and the lower band is the sample average change minus 1 standard deviation.

Based on this classification, and following the logic of a slightly modified Boston Consulting Group (BCG)'s "Growth-Share Matrix,"[1] we can identify four groups of countries:

1. *Rising stars:* Those countries whose NRI scores are above the sample average and whose scores are also growing more quickly than average. Armenia, Georgia, Kazakhstan, Panama, Qatar, and the United Arab Emirates belong to this group.
2. *Sliding stars:*[2] Those countries whose NRI scores are above average, but in which evolution seems to be lagging behind. Barbados and Denmark belong to this group.
3. *Question marks:* Those countries whose NRI scores are below average but that are quickly catching up. Bolivia, Ecuador, Haiti, Nicaragua, Peru, Suriname, Swaziland, and Yemen belong to this group.
4. *Laggards:* Those countries whose NRI is below average and that are lagging increasingly behind. Benin, Botswana, Burundi, Chad, Malawi, Mozambique, Timor-Leste, and Tunisia are in this group.

Figure A: The NRI 2014 compared with its evolution since 2012



Source: Authors' calculations.

(Cont'd.)

Box 1: Which countries are bridging the digital divide and which countries are not? An evolutionary analysis of the NRI results *(cont'd.)*

From this classification, we can learn several interesting things. First of all, several oil- and gas-rich economies in the Commonwealth of Independent States and Gulf Cooperation Council are quickly improving their digital ecosystems. The governments in these countries have recognized the importance of investing in ICTs as a way to diversify their economies and are quickly developing their digital infrastructure in order not to miss the digital revolution. Second, many countries in sub-Saharan Africa are lagging behind, with no sign of improvement over time. This gap may hamper their capacity to support further economic and social development as the positive impacts of ICTs become more and more apparent; this can have important consequences for their future economic development if actions are not adopted urgently. Third, in Latin America, those countries that are particularly lagging behind are making significant strides to improve their digital potential. The rest of the countries in the region remain fairly stable. Panama, as an exception, is one of the leading countries in the region that relentlessly continues to strengthen its digital potential. Fourth, Barbados, and especially Denmark (which has always scored at the forefront of the rankings), should not be complacent but should address any weaknesses in the conditions that may hamper their potential to take advantage of their ICT capacity.

Notes

1 See the BCG matrix, available at http://www.strategicmanagementinsight.com/tools/bcg-matrix-growth-share.html.

2 In the original Boston Consulting Group's classification, this group would be the "cash cows."

good business and innovation environment (7th) and improvements in its ICT infrastructure (4th), notably in terms of wider access to international Internet bandwidth per user. Overall, the country exhibits a robust uptake of ICTs by all major stakeholders—businesses (9th), government (11th), and individuals (18th)—who manage to leverage well one of the best and more affordable (20th) ICT infrastructures (4th). Coupled with a pro-business and pro-innovation environment (7th), these result in a strong innovation capacity (5th) and significant ICT-related economic impacts (9th). The ranking of the United States, the largest economy in the world, in the top 10 shows that fully leveraging ICTs is not dependent on small or medium-sized economies, but instead depends on undertaking the right investments and creating the right condition for it.

With the most pronounced improvement among the top 10, **Hong Kong SAR** climbs six positions to 8th place. The sharp improvement in its score is driven by improvements in conditions for innovation and entrepreneurship (2nd) that were already very positive, a robust skills base (10th), and stronger business (16th) and government usage (24th). Overall, Hong Kong SAR enjoys a fairly well developed ICT infrastructure that, coupled with a stable environment conducive to innovation and entrepreneurship (4th), results in good economic (13th) and social (11th) impacts. Notwithstanding these strengths, individual uptake remains lower than it is in the Nordic countries that lead the rankings.

Despite a drop of two places, the **United Kingdom** continues to exhibit a very strong performance in 9th position. As in the Netherlands, as a service-based economy, the country early recognized the importance of ICTs to support its innovation and competitiveness performance. As a result, it has managed to build a well-developed ICT infrastructure (15th), exhibiting one of the highest population uptakes (8th) and a well-developed e-commerce (1st), which, coupled with a strong pro-business environment, has resulted in solid economic (14th) and social (9th) impacts.

The **Republic of Korea** moves up one position, entering the top 10 this year. A country that has largely based its economic success on the ICT industry, Korea benefits from a strong ICT infrastructure (13th) and an excellent ICT uptake by individuals (9th), businesses (10th), and especially government (3rd), which ranks 1st in the world in terms of online services. The country's strong focus on developing its technological capacity as part of its economic development strategy has also resulted in a sturdy technological innovation performance (8th), notably in the field of ICTs (4th). Improvements in the conditions needed to support innovation and entrepreneurship (34th) could help Korea to leverage further its significant effort to become a leading knowledge-intensive economy.

EUROPE AND THE COMMONWEALTH OF INDEPENDENT STATES

Europe has been at the forefront of developing a digital ecosystem as a key ingredient that fosters innovation and competitiveness. As a result, several European countries lead the NRI rankings, with six European economies—Finland, Sweden, the Netherlands, Norway, Switzerland, and the United Kingdom—in the top 10. In addition, in order to maximize the positive impacts of ICTs throughout the European Union and create synergies and positive spillover effects, the European Commission has developed its Digital Agenda as one of seven flagship initiatives under its growth strategy Europe 2020.[9] Despite these efforts, important differences remain across European economies, with Southern and Central and Eastern European

economies continuing to lag behind. A deeper analysis of the root causes of these differences shows that, in general, ICT infrastructure and individual uptake is more homogeneous across EU Member States. However, less favorable conditions for innovation and entrepreneurship across European countries result in starker disparities in terms of the economic impacts—for example, innovation performance—accruing from their use, which illustrates the changing nature of the digital divide in Europe and in the rest of the world. The digital divide should not be regarded only in terms of access to ICT infrastructure, but also in terms of the impacts that using ICTs can provide for the economy and society in general. Box 2 develops this analysis further and provides some recommendations for policies that would help to bridge the European digital divide.

Luxembourg, in 11th place, climbs five places thanks to continued improvements across the board. The country continues to reap the benefits of significant past efforts made to develop the ICT sector as a key economic strategy for diversifying its local economy. With one of the best ICT infrastructures in the world (17th), Luxembourg counts on a high ICT uptake (8th), with both businesses (13th) and individuals (5th) using these technologies extensively. Combined with optimal business conditions and a reliable and efficient political and regulatory environment (4th), the country has persisted in improving economic impacts, thanks to more technological and non-technological related innovations (10th) and the highest share of the workforce working in knowledge-intensive jobs in the world. In order to maintain this good momentum, the country should persevere in enhancing its overall innovation system (29th) so that it can fully leverage its ICT potential.

Germany continues to rise, this year by one position, to reach 12th place, thanks to persistent improvements in its overall business environment (17th) and the perceived quality of its educational system (14th), which seems to provide the right set of skills to engage in an innovation-driven globalized economy. With a very good ICT infrastructure (11th), which translates into high levels of individual (11th) and business (5th) ICT uptake, Germany benefits from high levels of ICT-driven economic impacts (8th), as reflected in the excellent innovation capacity (3rd) of local companies.

Despite a drop of five places this year, driven mainly by a slight deterioration of its business environment (16th), **Denmark,** now at 13th place, continues to benefit from one of the highest rates of ICT usage (7th), with all stakeholders using ICTs in their everyday activities. More precisely, ICT uptake among individuals (3rd) is one of the highest in the world: almost the entire population has access to a computer and an Internet connection at home and uses the Internet; businesses use ICTs for their communication and transactions with other businesses (18th) and clients (14th); and governments offer a large share of their services online (13th). Despite this good performance, in comparison with other Nordic economies, there is some concern about the decreased ability of businesses to fully leverage ICTs to generate new services and products (33rd) and innovate by offering new organizational models (29th). These issues can potentially have a negative impact on an innovation-reliant country's ability to support further economic growth and social development.

Estonia moves up one place to 21st position thanks to improvements across many dimensions of the Index, notably ICT usage (22nd) by both individuals (17th) and businesses (28th). Following the model of neighboring Finland, the country has recognized the crucial role that ICTs have to play in the local economy and for social development. The result is that Estonia ranks 1st among the Baltic Republics, followed by **Lithuania** at 31st place and **Latvia** at 39th; it is also 1st among Central and Eastern European countries and well ahead of Southern European nations. With a well-developed ICT infrastructure (25th) and a good environment for business and innovation (28th), private companies have developed well-functioning e-commerce strategies (6th) and the country is managing to yield good economic (22nd) and social (4th) ICT-related results. Going forward, Estonia should follow the examples of its Nordic neighbors in developing a robust innovation system that can help further its decisive transition into a full-fledged knowledge-based society.

Moving out of the top 20, **Austria** drops three places to land at 22nd position, despite its very stable profile. Overall, the country boasts a very strong ICT infrastructure (10th) with high levels of business usage (11th), especially when interacting with other businesses (9th). Coupled with other innovation-related investments, such as research and development (R&D) and a favorable business environment (23rd), this results in a good technological performance both in the ICT sector (13th) and in the economy in general (10th). Further improvements in the entrepreneurial environment by easing the procedures to open new businesses (103rd), and in the quality of education in important areas for innovation, such as mathematics and science (39th), could help Austria leverage its digital potential better and obtain an even more robust innovation performance.

France moves up one position to 25th place, thanks to slight improvements in all three pillars of the readiness subindex: ICT infrastructure, affordability, and skills. Overall, the country presents a very harmonious uptake of ICTs across all agents, exhibiting one of the highest broadband Internet subscription rates in the world (4th), a fairly good development of e-commerce (27th), and a vast number of government services online (8th). Although some concerns about the business and innovation system (47th) exist—France has one of the highest tax systems in the world (136th) and relatively low levels of venture capital availability (49th)—the country manages to obtain

Box 2: The digital divide in Europe

Europe is slowly emerging from one the worst financial and economic crises in decades, but growth prospects remain unstable and unemployment stubbornly high in many countries, notably those most severely hit by the crisis. Technological progress and digitization can represent one of the main sources of potential economic growth and employment generation for Europe, as has been recognized by the European Commission.[1]

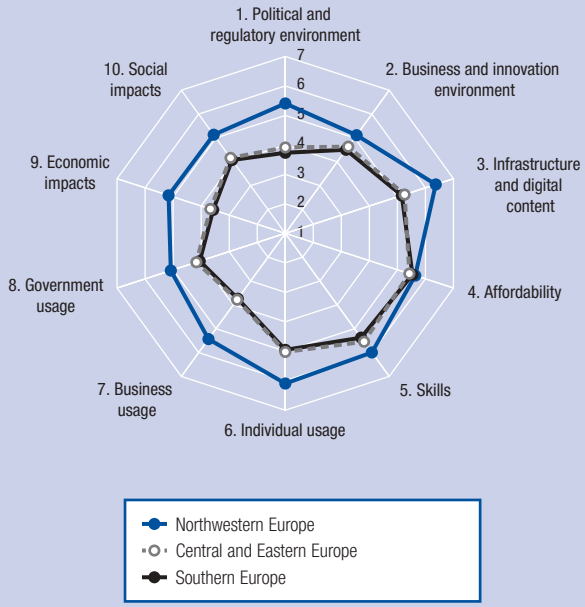
However, the level of digitization is not the same across European Union (EU) Member States, and thus the potential to benefit from ICT adoption remains uneven. An analysis of the Networked Readiness Index (NRI) results shows that, while many European countries are leading in the rankings and several Nordic and Western countries are within the top 10, many others continue to lag behind. A digital divide persists within the European Union.

Although it is difficult to create homogeneous groups of European countries in terms of their level of digitization and the benefits accruing from it, a broad classification by geography would show that Northern and Western Europe depicts much stronger results than Southern and Central and Eastern Europe, even if the situation differs broadly within these groups. For example, within Central and Eastern Europe, Estonia presents values similar to those of some of the countries in Western Europe; within Southern Europe, Portugal and Spain outperform Greece.

Figure A presents the NRI results for each of the 10 pillars for these three groups of EU Member States. Based on this analysis, a number of key findings can be highlighted:

1. The gap between Northwestern European economies and the rest of the Member States is reflected in all of the 10 pillars of the NRI, from the market and regulatory conditions that support high levels of ITC uptake to levels of usage by all stakeholders and the economic and social impacts accruing from ICTs.
2. Overall, most countries depict fairly well developed ICT infrastructures. Although some countries should continue strengthening these infrastructures, they may not be the main source of the digital divide in Europe.
3. The cost of accessing ICTs is similar in all EU Member States and thus should not be regarded as a primary source of different levels of ICT uptake.
4. The gap in ICT usage across countries is bigger for businesses and narrower across governments. Overall, governments in most EU Member States have recognized the importance of developing ICTs and offer a fairly large number of public services online. However, the differences among countries in the capacity of their businesses to develop and integrate ICTs in their business models are much starker.
5. The gap in terms of social and especially economic impacts is the widest of the four subindexes, illustrating the new nature of the digital divide in Europe. Because the benefits of ICTs increasingly permeate all activities, the digital divide within Europe becomes starker when viewed by considering the impacts that benefit different stakeholders.

Figure A: The NRI 2014: European Union



Source: Authors' calculations.
Note: Southern Europe includes Greece, Italy, Portugal, and Spain; Northwestern Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden, and the United Kingdom; and Central and Eastern Europe includes Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia.

These findings have several policy implications both for EU Member States and for the European Commission's effort to build a common Digital Agenda that stimulates a virtuous circle of investment in ICT infrastructure, higher uptake levels, and stronger impacts for all. Arguably the main implication is that digital strategies should focus not only on developing ICT infrastructure but also on creating the right conditions for an effective use of ICTs to boost innovation, competitiveness, and greater social inclusion. In order to do all that, public policies and company strategies are needed to improve the digital literacy of the population; to boost the overall skills capacity of the workforce through effective educational and training systems; and to encourage an effective integration of ICTs with other sources of innovation, such as R&D investments or higher levels of on-the-job training. To maximize their impact, these activities will need to be coordinated across stakeholders, so creating and strengthening public-private collaborations will be key.

Note

1 European Commission 2013.

good economic impacts (19th) and a large share of its population is employed in knowledge-intensive jobs (10th).

Benefiting from a fairly well developed ICT infrastructure (19th) and a pro-business and innovation environment (16th), **Ireland** moves up one position to 26th place. Since the early days of the Internet revolution, Ireland has identified ICTs as one of the key industries that could help diversify its economy and has attracted many global ICT companies thanks to its favorable environment for business. As a result, the island boasts good levels of digital connectivity that, coupled with a skilful labor force, has resulted in good economic impacts (18th) derived from technology-related innovations. On a less positive note, the government seems to lag behind in embracing ICTs in their offerings of online services (55th), which affects the country's capacity to fully leverage ICTs to increase their social impacts (55th).

Portugal and **Spain,** at 33rd and 34th position respectively, present fairly stable profiles. As in past editions, both countries have managed to develop good ICT infrastructures (36th and 32nd, respectively) and ICT uptake has permeated among their populations, particularly in Spain where almost three-quarters are Internet users (34th). In addition, both governments have made significant attempts to increase the number of services they offer online. Despite these efforts, both countries continue to struggle to fully leverage ICTs to boost innovation (42nd and 57th, respectively), and weaknesses in their innovation ecosystems persist, notably in Spain (51st). Addressing these weaknesses and integrating ICT investments better with other innovation-enhancing investments, such as R&D, would result in more robust economic outputs, which are needed for the economic transformation of these countries.

In Southeastern Europe, once again **Slovenia,** despite its current economic difficulties, continues to lead the rankings, moving up one position to reach 36th place. The country boasts a fairly robust ICT infrastructure (24th), along with good ICT uptake by individuals (34th) and government in its offering of online services (35th). Despite these positive features, Slovenia does not manage to completely leverage the full economic potential of ICTs for boosting innovation, where it continues to lag behind other EU countries. Weaknesses in Slovenia's innovation system, with low levels of venture capital (127th), a limited capacity to innovate (54th), and low levels of on-the-job training (105th) result in low levels of innovation, in terms of both new products and services (69th) and organizational models (68th), which hinder the productivity-enhancing potential of the economy. Within the region, **Croatia** follows at 47th place, with **Bosnia and Herzegovina** (68th) and **Serbia** (79th) lagging behind because of insufficient development of their ICT infrastructures, weak ICT uptake, and weaknesses in their innovation systems that hinder their potential to fully enjoy the benefits that can accrue from ICT.

In Central and Eastern Europe, the **Czech Republic** repeats last year's position at 42nd place, despite sharp improvements in rendering a fairly good ICT infrastructure (23rd) more affordable (84th), which has resulted in a slightly higher ICT uptake by individuals (30th). However, this improvement is set off by a slight deterioration in the political and regulatory environment (51st) that does not allow for better ICT-related economic (38th) or social impacts (47th). Overall, the country continues to depict strong ICT uptake by individuals, reflected by the fact that a large share of its population uses the Internet (28th) and e-commerce is well developed (9th). However, the government continues to lag behind in supporting and promoting the use of ICTs in their activities (96th), and weaknesses in the innovation and entrepreneurial systems (60th) hinder the country's capacity to fully leverage ICTs for improving innovation, competitiveness, and well-being.

Other countries in Central Europe—such as **Hungary** and **Poland,** at 48th and 55th place respectively—have lost some ground in the rankings because of the relatively faster progress of other countries, while the **Slovak Republic** improves its position by two places to reach 59th position. In addition, **Bulgaria** and **Romania,** 72nd and 76th respectively, drop one position each, depicting relatively stable profiles.

Despite a slight improvement in many indicators related to ICT infrastructure (42nd) and uptake (37th), which gives rise to a stable score, **Italy** suffers from a significant drop of eight places in the rankings to reach 58th place: other countries progress faster in building and fully utilizing their digital ecosystems. Persistent weaknesses in Italy's political and regulatory environment (99th), coupled with some significant challenges in its innovation system, hinder the country's capacity to fully leverage ICTs to boost innovation, competitiveness, and well-being.

As in the case of Italy, **Greece** suffers from a notable drop of 10 ranks despite a slight improvement in its overall score, coming in at 74th place this year. Continued improvements in its ICT infrastructure (40th) and the uptake of its citizens (43rd), as well as a rising number of broadband Internet subscriptions (27th) and Internet users (53rd), are not reflected in better, innovation-led economic (91st) or social (87th) impacts. Weaknesses in the country's political and regulatory environment (114th) coupled with a low capacity to innovate (117th) and scarce access to venture capital (146th) affect the country's capacity to introduce new services and products (129th) or organizational models (128th) that could help to transform its national economy and lead it toward more productive activities.

Within the Commonwealth of Independent States, several countries improve their performances, reflecting the key importance and hopes they have placed on ICTs to diversify their economies and lead them toward more knowledge-intensive activities.

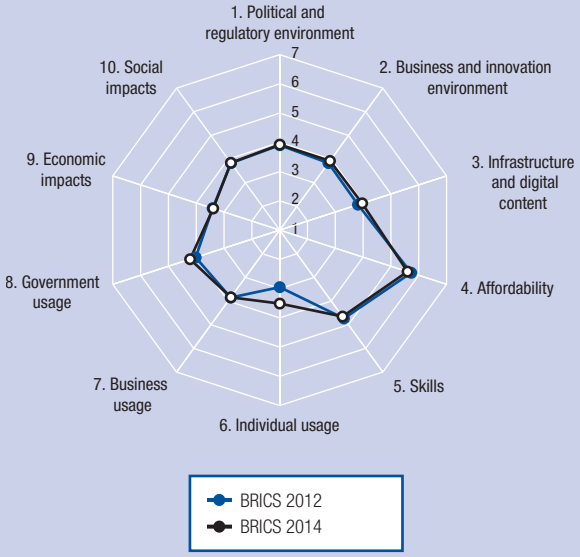
Box 3: Challenges faced by BRICS economies to fully leverage ICTs

Since the beginning of the worst financial and economic crisis of the past 80 years, the global economy has experienced a change in its traditional growth patterns. Advanced economies exhibited negative or sluggish growth, while emerging markets, and notably the BRICS economies—Brazil, the Russian Federation, India, China, and South Africa—continued to show robust growth. Several different reasons may explain these growth patterns for emerging markets; among them are the development of stronger domestic markets, an increase in the price of commodities, and access to more and better financing thanks to higher capital in-flows.

Notwithstanding this progress of the BRICS, we have recently observed that many of these emerging economies are experiencing difficulties in maintaining the rapid economic growth of these past years. Many of the favorable conditions fueling that growth have begun to fade away; this can have consequences not only for these particular countries, but—given their size and increasing importance in an interconnected world—also for the global economy.

In order to support sustained and stable growth in the long term, emerging markets must increase their levels of productivity, which they can do in two ways: by introducing the necessary reforms that will improve the functioning of their markets and boost their innovation potential, and by better leveraging their digital ecosystems. In terms of the latter, an analysis of the Networked Readiness Index (NRI) results for the past years shows that, in general, little progress has been achieved.

Figure A: The NRI in BRICS economies, 2012 and 2014



Source: Authors' calculations.

Table A: The NRI in BRICS economies, 2012 and 2014

	BRAZIL				RUSSIAN FEDERATION				INDIA				CHINA				SOUTH AFRICA			
	2012		2014		2012		2014		2012		2014		2012		2014		2012		2014	
	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value
Networked Readiness Index	**65**	**3.9**	**69**	**4.0**	**56**	**4.0**	**50**	**4.3**	**69**	**3.9**	**83**	**3.8**	**51**	**4.1**	**62**	**4.1**	**72**	**3.9**	**70**	**4.0**
Environment subindex	**101**	**3.5**	**116**	**3.4**	**100**	**3.5**	**87**	**3.8**	**78**	**3.7**	**91**	**3.8**	**64**	**3.9**	**77**	**3.9**	**34**	**4.6**	**31**	**4.8**
1. Political and regulatory environment	77	3.6	78	3.6	102	3.2	100	3.4	71	3.7	73	3.6	46	4.1	56	4.0	23	4.9	20	5.0
2. Business and innovation environment	121	3.5	135	3.3	83	3.8	73	4.2	91	3.8	103	3.9	105	3.7	115	3.8	50	4.4	53	4.5
Readiness subindex	**72**	**4.7**	**76**	**4.7**	**32**	**5.4**	**37**	**5.5**	**64**	**4.8**	**85**	**4.6**	**66**	**4.8**	**73**	**4.8**	**94**	**4.1**	**98**	**4.2**
3. Infrastructure and digital content	68	4.0	56	4.5	40	4.8	47	4.8	100	3.2	119	2.7	87	3.5	86	3.5	82	3.6	68	4.2
4. Affordability	67	5.3	91	5.0	17	6.2	14	6.4	1	6.9	1	7.0	42	5.7	60	5.6	94	4.6	112	4.0
5. Skills	86	4.7	91	4.6	53	5.2	64	5.1	100	4.3	101	4.0	57	5.2	59	5.2	101	4.3	97	4.3
Usage subindex	**54**	**3.8**	**47**	**4.1**	**60**	**3.7**	**53**	**4.1**	**78**	**3.4**	**91**	**3.4**	**51**	**3.8**	**61**	**3.9**	**76**	**3.4**	**70**	**3.7**
6. Individual usage	66	3.3	59	4.2	52	3.9	46	4.6	117	2.0	121	2.1	82	2.9	80	3.3	96	2.6	78	3.4
7. Business usage	33	4.0	41	3.9	83	3.4	84	3.4	47	3.8	51	3.8	37	4.0	44	3.9	34	4.0	30	4.2
8. Government usage	59	4.0	54	4.3	71	3.7	61	4.1	46	4.3	41	4.5	33	4.6	38	4.6	89	3.6	103	3.6
Impact subindex	**53**	**3.7**	**57**	**3.6**	**73**	**3.4**	**44**	**3.9**	**52**	**3.7**	**60**	**3.6**	**41**	**4.0**	**56**	**3.7**	**81**	**3.3**	**89**	**3.3**
9. Economic impacts	52	3.5	64	3.3	53	3.4	41	3.6	41	3.6	50	3.5	79	3.2	81	3.1	59	3.4	49	3.5
10. Social impacts	54	3.9	58	3.9	89	3.4	41	4.3	65	3.8	73	3.7	30	4.8	44	4.2	98	3.3	113	3.0

(Cont'd)

Box 3: Challenges faced by BRICS economies to fully leverage ICTs *(cont'd.)*

Figure A compares the NRI scores by pillar for the BRICS economies in the 2012 and 2014 editions. Overall, the results have remained stable in virtually all pillars, and notably so for the economic and social impacts accruing from ICTs. The only exception has been a slight improvement in the individual usage score, which reflects the significant effort made to facilitate a broader access to ICTs for a wider share of the population.

In comparative terms, however, this stability in the scores represents a drop in the global rankings because other economies are progressing faster in developing and leveraging their ICT potential. Table A shows that since 2012—with the exception of the Russian Federation, which rises six places in the rankings—all other BRICS economies have dropped over time, in some cases significantly, and are now classified around the middle of the overall rankings. A more nuanced analysis of the different subindexes confirms that this drop in rankings is particularly important for economic and social impacts, where only the Russian Federation manages to improve in both score and rank.

Reversing this situation will require the adoption of holistic strategies that support better development of ICT infrastructure and higher uptake of ICTs throughout these countries, including in rural areas. Although the vast expanse of these nations may represent a challenge, they should continue to invest in strengthening their ICT infrastructures and facilitating wider access to them. In addition, and very importantly, the conditions needed to better leverage ICTs need to be improved by integrating these technologies better into more robust innovation and entrepreneurial ecosystems that can support higher economic and social returns. Strengthening the institutional framework to support the development of ICTs, improving the quality of the educational systems and of the scientific and technological base in the country, and supporting interactions between research institutions and local companies will be thus be key going forward.

Kazakhstan is one of the most prominent of this group, leading the regional rankings at 38th, five positions up from the last edition. The country has improved its ICT infrastructure (58th), which remains one of the most affordable to access in the world (2nd)—an advantage that is also reflected in stronger ICT uptake by individuals (54th), with more than half of its population using the Internet or owning a computer with an Internet connection at home. The effort to upgrade the digital capacity of the country has been led by a strong government vision (27th) that recognizes the importance of promoting ICTs to diversify an economy that otherwise continues to be very reliant on the extraction of fossil fuels. Going forward, the country needs to continue building and strengthening its innovation system and the capacity of local companies to innovate (now 74th) to improve the economic impacts accruing from an increasing uptake of ICTs.

With a similar profile, **Azerbaijan** follows Kazakhstan closely in the rankings as it positions itself at 49th place, seven places up since the last edition. Improvements in the country's ICT infrastructure (55th), giving rise to much higher ICT uptake—especially by individuals (61st)—have yielded this positive result. Despite this advance, the country continues to lag behind in terms of fostering technological innovation, exhibiting low levels of overall and ICT-related patents (75th). To some extent this lag reflects the severe impediments existing in an incipient innovation system (77th) and the insufficient quality of its educational system (114th). Addressing these long-term challenges over the coming years will be crucial for Azerbaijan to diversify its economy and make it less dependent on oil revenues while transitioning toward a knowledge-based society.

Similar to other countries in the region, and in sharp contrast to other BRICS economies (see Box 3) the **Russian Federation** moves up four positions to enter the top 50 this year. Slight improvements in the country's ICT infrastructure, which has become more affordable, along with higher rates of individual uptake (46th), have resulted in this positive outcome. Despite this progress, the country continues to suffer from a fairly inefficient political and regulatory environment (100th) and weaknesses in its innovation system, including a poor quality educational system (85th) that hinders its capacity to fully leverage ICTs to innovate, either through new products and services (113th) or new organizational models (93rd). It is also worth noting that, although individual ICT uptake is rather good (46th), both government usage (61st) and a poor government vision for developing ICTs (102nd) as well as inferior business uptake (84th) to support its innovation potential (64th) and business activity (94th) remain in need of attention.

Within the region, **Georgia** at 60th place and especially **Armenia**—which has one of the sharpest improvements and reaches 62nd place this year—continue on their positive path toward higher positions in the rankings. In contrast, **Ukraine,** in the middle of a difficult political and social context, drops to 80th place, while the **Kyrgyz Republic** repeats its 118th position of the past edition.

ASIA AND THE PACIFIC

With three economies from the region in the top 10 of the NRI rankings and several countries showing improvement, Asia and the Pacific is very dynamic and active in developing its ICT agenda. Yet a significant digital divide persists between the most advanced economies—such as the Asian Tigers and Japan—and emerging economies and other trailing countries.

Regardless of their position on the development ladder, all Asian economies have much to gain from increased networked readiness. It will allow populations

of the least advanced among them to gain access to much-needed basic services, to improve government transparency and efficiency, and—for the most advanced—it will contribute to boosting their innovation capacity and allow them to attain higher levels of competitiveness.

Taiwan, China, slips to 14th place in this edition despite a stable performance in terms of score. This relative drop in the rankings is primarily the result of improvements in other countries. Taiwan remains at the frontier both as a high-tech manufacturer and as a technology-driven economy, with strong usage of ICTs among all society's stakeholders. In addition, the economy manages to improve its already developed infrastructure (5th) by, for example, expanding its international Internet bandwidth by a significant amount and by making access to ICTs more affordable (53rd). Consequently, the economy scores strong social (6th) and economic impacts (12th), although these could be increased further by addressing some weaknesses in its political and regulatory environment (34th). This remains Taiwan's main area for improvement, especially with its lengthy procedures to enforce contracts (131st).

Japan moves up five positions to attain 16th place this year. Although a link between this improvement and its current economic outlook cannot be established, renewed business confidence in the political environment may have contributed to this progress. In addition, Japan has achieved marginal improvements in its ICT infrastructure, which has become more affordable, and maintains its competitive advantage in the high innovation capacity of local firms (4th). Technology and innovation continue to play a key role in making Japan one of the most productive economies worldwide; these have managed to extend to society, as social impacts have continued to improve (23rd). Yet further improvements in social and economic impacts could be achieved by incentivizing a more dynamic environment that could, for example, foster innovation through new organizational models (37th). A more conducive institutional framework, especially the general business and innovation environment (40th), could contribute to delivering better results and boost competitiveness.

Australia occupies the 18th rank and is stable since last year, despite an improved score. The country registers a sharp improvement in the affordability of ICTs (49th) and in some notable aspects of individual usage, such as the penetration of broadband subscriptions. According to ITU, the increase in smartphone usage is leading to more handset data download because owners of smartphones are more likely to purchase goods, access video and audio content, pay bills, and use other online services.[10] This increased usage is partially reflected in some aspects of their economic impacts through the creation of new services, new products, and new organizational models. Compared with individuals, businesses and government are less dynamic in taking up ICTs.

Neighboring **New Zealand** (20th) shows a stable performance in the rankings with a slight advancement in score. The country's regulatory and business environment remains its strongest competitive advantage (2nd overall in the environment subindex, just behind Singapore). New Zealand ranks 1st for the independence of its judicial system and 1st in both the number of days and the number of procedures to start a business. The excellent skill base of its population (6th) also contributes to the country's ability to properly use and leverage a fairly good ICT infrastructure, although it remains rather pricy (127th), constituting New Zealand's main weakness.

Malaysia is also stable (30th) and confirms its leadership as the highest ranked economy in Developing Asia. Malaysia maintains relatively competitive regulatory (25th) and business (24th) environments, and its government continues to use ICTs extensively (9th), highlighting the high priority of this sector in the government's agenda. Business usage (27th) is also strong, as firms invest to adopt new technologies and make the effort to become increasingly innovative. The combination of a favorable environment and an overall high level of ICT usage results in high positive economic (30th) and social (25th) impacts. However, individual usage (49th), although improving in many dimensions, has yet to expand so that ICTs become a widespread technology in Malaysian households. This will certainly increase as the economy develops, but further investment in infrastructure and digital content (71st) are needed to ease access and foster even higher economic and social impacts.

China falls four places in the rankings this year and occupies the 62nd position overall, despite an increase in its overall score. The country is slowly improving its innovation potential but still lags behind in leveraging the full potential of ICTs. For example, despite an increase in patent applications, the overall level remains relatively low (32nd) with just 11.5 applications per million population. Individual usage is also growing, which explains most of the progress in China's score. However, only just over 40 percent of individuals use the Internet on a regular basis and there are only 13 fixed broadband Internet subscriptions for every 100 people (51st). Mobile broadband Internet has registered more substantial growth, but its penetration is still low, with 17 subscriptions per 100 population (76th). Consequently, individual usage in China still ranks low (80th), trailing behind the level of ICTs used by other stakeholders: business (44th) and government (38th). Certainly the vast size of the country and its proportion of rural population does not allow for rapid improvement in ICT usage and infrastructure build up, yet China needs to fill the gap to meet its ICT potential. Some of the constraints to better leverage ICTs that have been faced by the country in the past are not improving. The institutional framework does not lead to higher ICT uptake (56th), and the business environment (115th) witnesses a relative

worsening because of excessive bureaucracy and red tape, high taxes (135th), and delayed availability of new technologies (107th), at least at the national, aggregate level. In terms of readiness, China is making an effort to improve its infrastructure, with augmented production of electricity and higher international Internet bandwidth capacity and server security. Yet performance in these dimensions is still relatively low because improvements hardly keep up with the country's rapid development. Moreover, progress on the construction of hard ICT infrastructure is counterbalanced by a diminished accessibility of digital content (67th). And although the skill base of the workforce is growing (for instance, participation in secondary education is growing to reach 86.6 percent of its population), it is not growing as quickly as in other competing economies, and the country attains a relatively low 59th position on the skills pillar. Furthermore, the affordability of ICTs has dropped to 60th place, representing the main area of decline. All these limitations combine to realize only low economic impacts (81st), allowing a limited impact of ICTs on new services and products and a low share of the workforce employed in knowledge-intensive activities. Further and sustained efforts should be made to unleash the innovative potential of ICTs, both through investment in capacity building and infrastructure and through a more open and creative environment that could foster new ideas and business models.

Since the last assessment, **Indonesia** climbs 12 places to attain 64th position, the third best result among members of the Association of Southeast Asian Nations (ASEAN) after Singapore and Malaysia.[11] This result is achieved thanks to balanced improvements across the board rather than to a sharp increase in one particular area, although more significant progress takes place in the environment subindex. Both the political and regulatory environment (68th) and the business environment (62nd) are improving. The former is driven by stronger perceptions about the effectiveness of the country's institutions, with enhanced intellectual property protection (55th), a more efficient legal system (49th), and better-developed ICT regulations (46th). The latter is driven by stronger local competition (66th, up several positions since last year) and the greater availability of the latest technologies (60th), while venture capital availability remains high (17th) and slightly improving as well. However, further advancements can be achieved in this area, as excessive red tape continues to limit the creation of new businesses. Indonesia's readiness also improves. While affordability remains one of its main strengths (37th), progress in skills and infrastructure add to the country's fairly solid performance. After having achieved full mobile network coverage last year, its international Internet bandwidth capacity improves significantly to reach 77th place. In terms of skills, the quality of its educational system is improving as well as its population's participation in higher education, with a secondary education enrollment rate of 81 percent. Yet readiness can be further enhanced by continuing investing in education and especially in ICT infrastructure, where the capacity of secure Internet servers (105th) and electricity production (104th) remain insufficient to sustain future ICT development. Usage, also on a positive trend, has stayed more stable. Across stakeholders, businesses (36th) lead, with companies quickly absorbing the latest technologies and increasingly integrating ICTs in their daily activities. Businesses are followed by the government (49th), while households continue to lag behind (95th). The penetration of mobile phones passed 100 subscriptions per population a few years ago, mobile broadband subscriptions are rapidly evolving, and social networks are popular. However, the low usage of the Internet (112th) and the scarce availability of personal computers (103rd) and home Internet connections (117th) still reflect gaps in the fulfilment of Indonesia's ICT agenda. Consequently, economic and social impacts (86th and 63rd, respectively) are increasing but still low compared to the tremendous improvements registered in the few years. It is hoped that the benefits of ICTs are building up and will be secured in the near future.

Thailand, similar to most other ASEAN members, improves its performance this year, reaching 67th place in the rankings. Despite the wide gap vis-à-vis Singapore and, to a lesser extent, Malaysia, Thailand exhibits progress in all the subindexes. Its main strengths lie in its relative affordability of ICTs (47th) and its business and innovation environment (45th). However, in both these pillars Thailand alternates good results with areas for improvement. For example, in terms of affordability, the accessible mobile phone tariffs (30th) are counterbalanced by less competitive broadband Internet prices (86th). Similarly, the business and innovation environment includes a high level of local competition (41st) as well as low government procurement of advanced technology (105th). Business usage is another area of relative strength (59th), thanks to the widespread use of ICTs for consumer transactions (50th) and also to active technology absorption (50th). Individual usage of ICTs still lags behind (85th), yet it shows significant improvement with a good penetration of mobile phones (38th) and usage of virtual social networks (49th), comparable to those of advanced economies. Yet, aside from mobile telephony, other technologies remain relatively scant, especially the breadth of mobile broadband technologies (132nd). Moreover, the institutional environment does not seem to be particularly conducive (79th) and the government does not appear to be particularly eager to push the digital agenda nationwide (84th). The resulting economic impact is therefore not yet satisfactory (104th), with few ICT PCT applications, few organizational models, and a low share of the workforce in knowledge-intensive activities.

Sri Lanka, another ASEAN economy, drops seven places to take the 76th position in the rankings, but its score continues on a positive upward trend. The environment subindex, both in its political and regulatory component and in its business and innovation component, loses some ground, yet this is compensated for by stronger usage, especially among business (50th) and government (43rd) stakeholders. Individual usage is also improving, but because it is starting from a very low base (112th) it still needs to fill important gaps across the board, while the country's infrastructure (104th) demands sustained investments to support the ICT sector adequately.

India is the least performing of the BRICS economies and is continuing on its declining trajectory to arrive at 83rd place in this edition. The drop in rankings can be traced back mainly to difficulties in improving historical limitations and keeping up with other emerging economies in several dimensions. Overall, India's networked readiness profile remains hindered by the quality of its political, regulatory, and business environment (91st) and its lack of digital infrastructure (119th), which is reflected in low individual usage (121st) and wide gaps in education participation that limit the creation of a wide skill base (101st). Red tape and corporate tax continue to create a difficult environment for businesses to operate, with almost no improvements since the last assessment. On this dimension—despite the positive availability of venture capital (27th), competitive local markets (24th), the availability of the latest technologies (58th), and improving perceptions of judicial independence (40th)—bureaucracy and administrative costs are extremely burdensome. For example, enforcing contracts remains a long process, both in terms of number of procedures (134th) and time (146th). In terms of readiness, the development of the country's infrastructure proceeds slowly: for example, electricity production expands, but remains insufficient overall (101st); the number of secure Internet servers also increases but remains low (108th). However, the most worrisome signals of insufficient progress on the digital agenda come from the lack of skills buildup, with dismal progress made in secondary education participation (68.5 percent, ranking 105th) and literacy rate (127th). The inadequate diffusion of basic skills required in a knowledge society is certainly a drag on ICT development and hinders leveraging the yet-untapped innovation potential of large, young Indian human resources. The low level of ICT usage by households and individuals reflects the strong human, infrastructure, and digital divides that characterize India. The penetration of mobile phones is low (69.9 percent) and not growing, while the numbers of Internet users (12.6 percent), households with a personal computer (10.9 percent), and mobile broadband subscriptions (5 percent) are disappointing (all ranking below the 102nd position). The main strength of India lies in its very affordable set of ICT tariffs (1st) and its businesses' capacity to adopt new technology (48th). The government continues to emphasize ICTs as a promising tool to address some of the country's priorities such as job creation, corruption, red tape, and education. However, this vision has yet to translate into a structural transformation of India's economy and society.

Improving its position both within the ASEAN group and overall, the **Philippines** climbs eight places to reach the 78th position. With a significant improvement in its overall score, the country continues its positive trend. The scores of all the 10 networked readiness pillars register an increase. A significant improvement in the perceived efficiency in the country's legal system and property rights protection drive the political and regulatory environment up to 87th place. ICT readiness is the other area where the Philippines improves the most, thanks to a more affordable (75th) access to ICT infrastructure and better skills (69th), despite the need for higher quality in the educational system. Business usage is, as in many other Asian economies, at a more advanced stage (43rd) than individual usage (91st). Progress made in terms of economic impacts registered last year continues this year, moving up eight positions and reaching 48th place. The role of ICTs in fostering innovation by creating new products and services (42nd) and organizational models (28th) is confirmed and contributes to this promising result.

With a stable performance, **Vietnam** is overtaken by the Philippines in the ASEAN group but remains 84th overall and marginally improves its score. The affordability pillar is corroborated as the main strength of Vietnam's performance (8th), jumping 30 positions since the last assessment. The business and innovation environment is the other main area where Vietnam progresses significantly, albeit from a low base (100th this year). The other many shortcomings endure: the poor overall quality of the political and regulatory environment (91st) and ICT infrastructure (121st) limit the expansion of the ICT sector, while available skills (88th) show no signs of development. The usage of ICTs by individuals (84th), businesses (88th), and government (58th) remain stable, with little progress registered since the last assessment. Such a lack of dynamism not only is detrimental to the development of ICTs, but also seriously undermines the country's competitiveness going forward.

The eight ASEAN members covered by the NRI in the last edition improve their overall scores and a majority make progress in the rankings as well, although some continue to be located toward the lower end: **Cambodia** (108th), the newly covered **Lao PDR** (109th), and **Myanmar** (146th) close the regional rankings.

Finally, **Bhutan,** assessed for the first time this year, ranks 94th; **Pakistan** is ranked 105th, down three places; **Bangladesh** is 114th, losing one position; and **Nepal** is 126th.

LATIN AMERICA AND THE CARIBBEAN

Improving the connectivity of the region continues to represent one of its main challenges despite the recent efforts of many countries to develop and update their ICT infrastructures. Countries such as Chile, Panama, Uruguay, and Colombia have made significant progress in developing and ensuring more and better access to ICT infrastructure, ensuring higher ICT usage across stakeholders. However, persistent weaknesses in the broader innovation system hinder the overall capacity of the region to fully leverage ICTs to foster its competitiveness potential, highlighting the rise of the new digital divide—that is, the divide between countries that are achieving positive economic and social impacts related to the use of ICTs and those that are not.

Despite a slight increase in its overall score, **Chile** drops one notch to 35th place while still leading the regional rankings. As mentioned above, the country relentlessly continues to develop its ICT infrastructure and ensure higher ICT usage across stakeholders, with one of the highest rates of Internet users (45th), e-commerce (35th), and online government (24th) services in the region. Despite this important progress, weaknesses in its innovation system, which are reflected in the relatively low capacity of Chilean companies to innovate (63rd) and concerns about the quality of its educational system (74th), especially math and science education (107th), continue to hinder Chile's capacity to fully leverage ICTs to support innovation and the transition to a knowledge-based economy.

Panama continues its ascent in the rankings, moving up three spots to 43rd place. The country has recognized the importance of ICTs as one of the key sources of economic growth for the future both as an industry and as an enabler for innovation, notably in the service sector. This governmental vision (22nd) is reflected in higher rates of ICT uptake by businesses (39th) and individuals (68th), even if the reported figures do not reflect the government's efforts to provide free universal Internet access. Notwithstanding this progress, the country still suffers from weaknesses in its educational system (75th), notably in important areas for innovation such as math and science (114th), and in its political and regulatory environment (62nd). Panama's overall capacity to innovate is also still low (50th). These weaknesses hinder its ability to fully leverage its digital potential to foster higher levels of competitiveness.

Stable at 53rd place, **Costa Rica** exhibits some progress in ensuring higher ICT uptake, with an important increase in the number of households with access to an Internet connection (59th) and a higher proportion of its population with mobile broadband subscriptions (70th), thanks to efforts to guarantee affordable (15th) access to the ICT infrastructure. Notwithstanding these strengths, overall individual (64th) and government (64th) usage remain a bit low, and some weaknesses in the political and regulatory environment (63rd)—notably in the effectiveness of law-making bodies (140th) and the number of days to enforce a contract (123rd), as well as the conditions needed to boost innovation and entrepreneurship (70th)—affect the country's capacity to leverage its ICT potential to foster innovation and ensure the transition toward a knowledge-based economy (65th).

Barbados suffers a significant drop in the rankings, falling 16 positions to arrive at 55th place. This decline is driven by sharp increases in the price of accessing its ICT infrastructure and a drop in the economic impacts derived from ICT usage (57th). Overall, the Caribbean island continues to boast an excellent educational system (6th) that, coupled with a relatively favorable environment for business (38th), could result in higher economic impacts than those yet achieved. However, weaknesses in its innovation system, where companies report low levels of capacity to innovate (81st) and difficulties in accessing venture capital financing (98th), along with long and cumbersome procedures to start a business (94th), continue to hamper its innovation potential and thwart its ability to leverage the digital ecosystem. Going forward, addressing these weaknesses while continuing to improve its ICT infrastructure and uptake would result in greater economic and social impacts.

Despite the improvement in score that reflects the effort **Uruguay** has made to boost its ICT infrastructure and uptake over the past years, because other countries are progressing more quickly the country drops four places to land at 56th place. As in past years, Uruguay continues to improve its ICT infrastructure (50th), which has become more affordable (80th), resulting in higher levels of uptake by individuals (48th). Notwithstanding this progress, the country continues to suffer from weaknesses in its overall innovation system: of concern is the quality of its educational system (120th) and its capacity to provide the necessary skills for a changing economy, as well as its low capacity to innovate (88th). This situation results in modest economic impacts (61st) in terms of fostering innovation and ensuring a faster transition toward a knowledge-based economy (66th).

Colombia moves up three positions to reach 63rd place this year. Improvements in its ICT infrastructure, which has become relatively more affordable (44th), and in individual uptake (77th)—with a larger number of Internet users (66th) and households with a personal computer (74th) and an Internet connection (75th)—have allowed for this positive result. Notwithstanding this progress, the country continues to suffer from poor framework conditions for entrepreneurship and innovation (104th) and from weaknesses in its educational sector, notably in the quality of math and science education (108th), resulting in a poor capacity to innovate (83rd) and a small share of its population engaged in knowledge-intensive jobs (89th).

Despite a slight increase in NRI score thanks to improvements in its ICT infrastructure (56th), **Brazil** drops nine positions to arrive at 69th place because other economies have been faster to embrace the digital revolution. Overall, the country exhibits relatively high levels of ICT usage, with about half of its population using the Internet, a well-developed e-commerce industry (30th), and a government committed to offering a significant number of its services online (32nd), resulting in fairly good citizen e-participation (31st). However, a poor business and innovation environment (135th), coupled with weaknesses in its educational system (121st)—notably in the area of math and science (136th)—hampers the full attainment of the economic impacts that ICTs can provide (64th). Only a small proportion of its population is engaged in knowledge-intensive jobs (75th).

After a couple of years of important improvements in the rankings, **Mexico** does not consolidate past gains and falls 16 positions to reach 79th place. Despite some progress in expanding and upgrading its ICT infrastructure (81st) and uptake by individuals (89th), this is insufficient to catch up with advances in other economies, and thus Mexico does not manage to digitally converge with more-advanced economies. The cost of accessing its existing ICT infrastructure remains high (93rd) and the quality of its educational system (119th) continues to pose a severe challenge to providing the country with the skills necessary required for a changing and more digital economy. All this results in low ICT usage levels by both individuals and businesses, in spite of the government's significant efforts to offer many of its services online (28th), thereby enabling good rates of citizen e-participation (25th). In addition, its innovation ecosystem needs strengthening and, in general, Mexican companies have a low capacity to innovate (75th), resulting in low economic impacts (80th) and a population that concentrates largely on low-productivity activities and few jobs considered to be knowledge intensive (97th). A full implementation of the country's digital agenda and addressing the persistent weaknesses in the innovation system should help in resolving several of these persistent challenges.

Peru jumps 13 places to attain 90th position, thanks to some improvement in its ICT infrastructure—for example, greater access to international Internet bandwidth and higher individual uptake. Despite this progress, the country continues to lag significantly behind in terms of its capacity to fully leverage ICTs to build its competitiveness and modernize its economy, which continues to rely heavily on mining. Overall, weaknesses in its educational sector (134th), which does not seem to provide the right set of skills, coupled with relatively low deployment of its ICT infrastructure (95th), result in low levels of ICT uptake by both individuals (94th) and businesses (89th). In addition, weaknesses in enabling conditions for leveraging digital capacity for innovation (93rd), along with a weak political and regulatory environment (119th) and an excessive number of days to open new businesses (103rd), result in a poor innovation capacity (106th) and an economy that is not able to offer many knowledge-intensive jobs (94th). Improving the development of ICT infrastructure and access to it, coupled with better conditions and interaction with other innovation-related investments—such as education, training, and R&D—would help to improve the situation going forward.

Argentina drops one position to reach 100th place. In general, the country boasts few changes since last year. Although the development of an expensive (121st) ICT infrastructure (78th) and uptake by individuals (57th) present values above the Latin American average, the severe weaknesses in its business environment (135th) and concerns about the quality of its educational system (104th) and its ability to provide the workforce with the necessary skills for the economy result in this disappointing position.

Finally, **Paraguay** (102nd), **Venezuela** (106th), **Honduras** (117th), **Bolivia** (120th), **Nicaragua** (124th), and **Haiti** (143rd) close the regional rankings. These countries all suffer from both important weaknesses in the development of their ICT infrastructures and a lack of the innovation and entrepreneurial conditions that could help them fully leverage them.

SUB-SAHARAN AFRICA

Sub-Saharan Africa slowly continues to develop its ICT infrastructure, especially by expanding the share of the population covered by, and having access to, mobile telephony and by expanding the number of Internet users, which in some countries—such as South Africa—has almost doubled. These improvements have led to many important innovations that provide more and better services that were previously unavailable, such as financial services. Notwithstanding this progress, the region overall continues to suffer from a relatively poor ICT infrastructure, which remains costly to access, although some notable exceptions exist. More importantly, severe weaknesses persist in the region's business and innovation ecosystems, which result in very low positive economic and social impacts. Addressing these weaknesses, not only by developing a more solid ICT infrastructure but also by improving the framework conditions for innovation and entrepreneurship, will be crucial to avoid the emergence of a new digital divide that will be evident in a disparity of the economic and social impacts associated with what has been called the digital revolution.

Mauritius recovers the ground lost last year and moves up seven positions to attain 48th place. Gains across the board—most notably in terms of a better ICT infrastructure and skills base, along with a higher level of individual usage—have led this improvement. Overall, the government's vision (31st) to develop ICTs as a key

sector to support the economic development of the island, coupled with a positive political and regulatory environment, have resulted in improvements in an affordable (11th) ICT infrastructure and higher levels of ICT users, even if less than half of its population uses the Internet or has a computer with an Internet connection at home. Improving the economic impacts (70th) accruing from a higher use of ICTs will require resolving some important weaknesses in the innovation system, such as the capacity of local companies to innovate (72nd), which is still considered low.

Despite some important improvements in the penetration of ICTs among individuals, which is reflected in a higher NRI score, **South Africa** remains stable at 70th place. In the past year, an expensive (112th) ICT infrastructure (68th) has exhibited little progress. In using ICTs, the business community (30th) seems to have taken the lead, using ICTs vigorously in interactions with other businesses (30th); this business-to-business use seems much more developed than interactions with consumers (62nd). On the other hand, the government (103rd) lags substantially behind in embracing ICTs, offering few online services (80th), which in turn results in low social impacts (113th). Weaknesses in the innovation system, notably in terms of skills development (97th), also affect the country's economic potential (49th) despite its fairly robust political and regulatory environment.

In the bottom half of the rankings, **Rwanda** moves up three positions to reach 85th place, regaining some of the ground lost last year. Overall, the country depicts a profile similar to that of previous years. It makes little progress in improving its very expensive (128th) ICT infrastructure (108th), which results in a low uptake by its population (138th) despite the clear vision of the government (5th) to promote ICTs in the country. Weaknesses in its innovation system and the low share of its population that graduates from secondary education (139th) also affect its capacity to fully leverage ICTs to boost innovation (93rd) or increase its population's online participation (112th).

Despite some very significant efforts to boost its ICT infrastructure and ICT uptake by its population, **Kenya** remains stable at 92nd place. As in the case of Rwanda, despite a strong government vision (26th) to develop ICTs, the actual uptake by its population (113rd) continues to remain very low, albeit increasing: only around 10 percent of households have a computer (113th) or an Internet connection (103rd). Weaknesses in the innovation and entrepreneurial environment (110th) and a fairly low skills base (98th) also affect the capacity of the country to fully achieve the potential benefits accruing from ICTs.

In East Africa, **Zambia** (110th) and **Uganda** (115th), swapping places from last year, and **Tanzania** (125th) continue to lag behind in developing their ICT infrastructures, promoting higher ICT uptake, and finally benefiting from the economic yields associated with it. The situation is similar in West Africa, where many countries—such as **Senegal** (113th), **Gabon** (128th), and **Cameroon** (131st)—remain at the bottom of the rankings as a consequence of both the insufficient development of their ICT infrastructures despite important progress made in their mobile telephony uptake, and weaknesses in their innovation systems that result in a low capacity to boost their overall competitiveness. Efforts to close the digital divide in these countries should focus not only on developing their ICT infrastructures but also on improving the framework conditions for innovation in order to avoid the perpetuation of the gap in economic and social impacts that constitute the new digital divide.

THE MIDDLE EAST AND NORTH AFRICA

As in previous years, the region depicts a highly diversified outlook in terms of the capacity of countries to leverage ICTs to boost competitiveness and well-being. On the one hand, Israel and several Gulf Cooperation Council states have continued their efforts to improve ICT uptake and integrate ICTs better in more robust innovation ecosystems in order to obtain higher returns.[12] On the other hand, many countries in North Africa continue to lag behind and suffer from important weaknesses in their framework conditions and overall innovation capacity that prevent them from fully leveraging ICTs and obtaining higher returns.

Israel repeats its position at 15th place, leading the regional rankings with a stable profile. The country continues to boast a fairly good ICT infrastructure (29th) that remains affordable (35th) and results in very high levels of ICT usage (14th) across all agents. Around three-quarters of the country's households count on a personal computer (21st) and Internet connection (29th) at home and are Internet users (31st), and more than half of its population has access to mobile broadband (26th). The government has also made a significant effort to offer its services online (15th), and e-commerce (23rd) is fairly well developed. In addition, the country benefits from a rather skilful labor force (39th), despite some concerns about the quality of education (56th), that—coupled with favorable conditions for innovation and entrepreneurship (14th) and a high capacity of companies to innovate (4th)—result in very high technological capacity, as evidenced by the high number of overall patents (5th), notably in ICT-related fields (4th).

Qatar remains stable at 23rd place and leads the rankings in the Arab world. In the past year, the country has continued to improve and upgrade its ICT infrastructure (31st) and uptake (18th), thanks to a decisive effort led by the government's strong vision (3rd) that has identified ICTs as one of the key industries that will diversify the local economy and boost the productivity of all sectors. Qatar is among the top 10 in the world in terms of Internet users (9th) and households having access to a computer (8th) and Internet connection (10th), which has become almost

universal and has helped to achieve very high social impacts (8th). Economic impacts (32nd), while improving, could be higher. Technological innovation (46th) remains modest, and just a quarter of its population is employed in knowledge-intensive jobs (61st). Continuing to address some of the weaknesses in its innovation system, which is quickly evolving and strengthening, would result in a higher technological potential.

The **United Arab Emirates** continues to move up in the rankings, this year by one position, to reach 24th place. Improvements in its ICT infrastructure (30th) and ICT uptake by individuals (29th) have led to greater economic impacts (27th) and thus the rise in the rankings. As in Qatar, the government has a strong vision (1st) to develop ICTs as one of the key industries to diversify the local economy; this is reflected in the already high and rapidly increasing levels of ICT uptake across all stakeholders. More precisely, 85 percent of its population use the Internet (14th) and have access to a personal computer at home (18th); government services are largely available online (9th) and e-commerce is relatively well established (20th). Benefiting from a pro-business environment, the country also obtains fairly good economic impacts (27th), even though its technological innovation capacity remains low (49th). Sustaining efforts to strengthen its innovation ecosystem will be important going forward in order to boost the potential results of a fairly well developed digital ecosystem.

Stable at 29th place, **Bahrain** continues to depict a robust performance. Although ICT infrastructure, especially in terms of international Internet bandwidth (74th), may not be as well developed in Bahrain as in other countries, it is less costly to access (25th) and uptake by individuals is one of the highest in the world (14th), with a very high number of Internet users (10th); the number of households with a personal computer (3rd) is similar to that of the Nordic countries. As for other countries in the region, the government has a strong vision to develop the sector (14th) and offers a wide range of services online. Notwithstanding these strengths, Bahrain suffers from an overall low capacity to innovate (82nd), which reflects persistent weaknesses in its innovation system. Along with some concerns about the quality of its educational system (48th), notably in math and science (77th), these weaknesses hamper the country's capacity to obtain higher economic impacts (63rd) and transition toward a knowledge-based economy (74th).

Despite some significant improvement in the uptake of ICTs by individuals and development in its infrastructure, **Saudi Arabia** falls one position to reach 32nd place. Overall the country depicts a very stable profile compared with that of previous editions. Similar to others in the region, the government (6th) is leading the effort to digitally connect and advance the country, while individual uptake (44th), despite recent improvements, and business uptake (34th), with a limited development of e-commerce (54th), lag a bit behind. Notwithstanding a fairly business friendly environment (23rd) that should continue its efforts to cut red tape (107th), weaknesses in its innovation system do not allow the economic impacts that ICTs could bring (37th). Going forward, strengthening its innovation system through more and more efficient investments to foster the scientific and technological capacity of the country will be important to increasing the share of its population working at knowledge-intensive jobs (67th) and helping the transition from a resource-based economy toward an innovation-driven one.

In the Levantine, both **Jordan** and **Lebanon** improve their scores, but while Jordan moves up three positions to 44th place, reaffirming its leadership in the area, Lebanon drops three to 97th place.

In North Africa, countries—except Algeria—suffer significant drops and are positioned in the lower half of the rankings, illustrating the difficulties they face if they are to fully develop their ICT potential and leverage it to obtain great social and economic impacts. **Tunisia,** at 87th place, leads the area, followed by Egypt, Morocco, and Algeria at 91st, 99th, and 129th place, respectively.

Egypt, at 91st place, falls 11 positions despite a slight improvement in individual ICT uptake (71st), which has nevertheless been smaller than the improvement seen by other countries that have evolved faster. Overall, Egypt continues to lag behind in terms of developing its ICT infrastructure (99th), although it remains fairly affordable (16th). ICT uptake by government is average (42nd), but penetration among citizens (71st)—with less than half its population using the Internet (75th)—and businesses, in their interaction with other businesses (81st) and consumers (70th), remain modest. Weaknesses in the political and regulatory environment (115th) and the business and innovation environment (117th) result in a low innovation capacity by Egyptian companies (111th) and thus limited economic (59th) and social (65th) positive outcomes.

Falling 10 positions, **Morocco,** at 99th place, barely ranks among the first 100 analyzed economies. As in the case of Egypt, ICT infrastructure (93rd) has slowly improved. This is also the case of individual ICT uptake, although progress in Morocco has been slower than in other countries that are moving faster. Overall, the country's economic (123rd) and social (115th) impacts remain very low, partly as a consequence of the relatively low ICT uptake, partly because of the poor conditions for boosting innovation and entrepreneurship (88th) in the country, and partly because of its low skills base (111th). In comparative terms, individuals are more advanced in using ICTs, with more than half of its population using internet (57th), than both businesses, where e-business still lags behind, and the government, which notably scores poorly in terms of its offerings of online services (125th).

After a sharp drop in the past edition, **Algeria** manages to move up two positions to reach 129th place. With very poor general conditions for business and innovation development (145th), a poorly developed ICT infrastructure (127th), and very low ICT penetration across all stakeholders, it is not surprising that the country does not achieve higher economic (133rd) and social (140th) impacts.

CONCLUSIONS

With the advent of the information revolution, ICTs have become ubiquitous and the world hyperconnected, deeply transforming the economic and social relationships across stakeholders. In this environment of fast-paced change, a new form of asset that can be thought of as the gold or oil of previous economic revolution periods has emerged: data. Large amounts of data, often referred to as *big data,* are constantly generated both in a structured and non-structured manner. Thanks to advances in ICTs, the volume and velocity of generation of these data are unprecedented, as is the capacity of organizations to capture and treat them, potentially generating great economic and social value. However, success in extracting this value requires more than just the generation of or access to big data. Organizations, both public and private, need to decide how to acquire, treat, and interpret these data. This will frequently require new management philosophies and organizational structures capable of adapting and benefiting from the new market opportunities. At the same time, the potential of big data to be misused is also increasingly becoming a source of concern. Privacy issues, and sometimes concerns about geopolitical and strategic matters regarding national security, have been raised. Measures that can build resilience and avoid these perils will need to be developed.

Against this backdrop, for the past 13 years, the Networked Readiness Index (NRI) of the GITR series has contributed to better understanding and measuring the determinants and impacts that ICTs can make, analyzing national conditions and stakeholders' readiness to fully leverage the potential that ICTs unveil. An analysis of the digital landscape confirms some of the key findings that have been presented in previous editions. Overall, the digital divide between advanced economies and emerging and developing ones persists. This is notable especially in terms of the economic and social impacts that ICTs can provide and that characterize the changing nature of this digital divide. The NRI results show that many developing and emerging countries have made significant attempts to develop their ICT infrastructure—mainly by increasing mobile telephony, which has become increasingly available for a large share of the population and has resulted in new services, such as financial services, that were previously unavailable. However, progress in building and upgrading the enabling infrastructure to allow for more and higher quality Internet connections or to expand ICT uptake has been slower, especially in the least-developed countries. In addition, these countries suffer from unfavorable business and innovation conditions and weaknesses in their educational systems, hindering their capacity to fully leverage the existing ICT uptake and resulting in lower innovation and competitiveness capacity. This situation is particularly worrisome in sub-Saharan African countries. On a more positive note, some countries, notably in the Commonwealth of Independent States and the Gulf Cooperation Council, have made significant progress over the past years, channeling many of the fossil fuel revenues toward ICT investments as a strategy to diversify their economies and make them less dependent on volatile international energy prices.

Another trend that is confirmed by the results is that large intra-regional disparities persist across all regions: from Latin America to Asia and the ASEAN countries, from the Middle East and North Africa to Europe and the EU countries. In Latin America, the regional rankings continue to be led by Chile, Panama, Costa Rica, and Uruguay—countries that portray relatively good results, albeit with some weaknesses in their overall innovation systems, in terms of increasingly developing their digital ecosystems. On the other hand, little progress is recorded for countries such as Brazil, Mexico, Argentina, Bolivia, and Venezuela. Within Asia and the ASEAN countries, the differences are also stark. Although Singapore continues to be at the forefront of the global rankings, Malaysia is the only other economy from the region that manages to score within the top 30, followed distantly by Indonesia and Thailand just above the top half of the rankings; Pakistan, Bangladesh, and Nepal come in toward the bottom of the rankings. In the Middle East and North Africa, the differences have become even more pronounced. While many countries from the Gulf Cooperation Council, especially Qatar and the United Arab Emirates, have continued their decisive progress toward strengthening their digital and innovation ecosystems, countries in North Africa continue to suffer from significant challenges to promoting ICT uptake and from poor conditions that present obstacles to integrating ICTs and leveraging them to boost innovation and competitiveness. Finally, in Europe, notably even within the European Union, the differences are also significant. A deeper analysis reveals that differences in terms of fostering ICT infrastructure and uptake are not so prominent—to a large extent, this is thanks to the efforts of the European Commission to develop a robust digital infrastructure throughout the Union. However, differences across countries in the conditions under which innovation can occur affect their capacity to fully take advantage of the existing infrastructure. Efforts to continue bettering these conditions for innovation will be key to reducing this new digital divide going forward.

Finally, of special importance given their size and influence in the global economy, is the situation of the

BRICS economies—more precisely, their inability to make decisive progress in developing and leveraging their ICT potential. Overall, although the situation differs across the five economies, they all seem to face difficulties in developing and benefiting from their digital potential. While their vast geographical expanse may hinder their capacity to quickly and more economically develop their ICT infrastructure and reach out to larger shares of the population, weaknesses in their innovation systems persist despite the many efforts to mitigate these limitations. This situation hampers their potential to benefit from the economic and social benefits that ICTs could bring about to boost their competitiveness and allow them to transition toward full-fledged knowledge-based societies.

The GITR series and the NRI provide a comprehensive analytical framework for assessing not only the progress made in raising ICT connectivity in different countries, but also—and more importantly—the progress made in obtaining the desired economic and social impacts that higher connectivity and the rise of big data can yield in generating growth and high-quality employment in a rapidly changing context. Designed and produced as a framework for multi-stakeholder dialogue, it also serves to identify and define policies and measures that can catalyze change toward better leveraging ICTs and achieving their full potential.

NOTES

1 Alexander 1983.

2 Google, no date, *Explore Flu Trends Around the World,* available at http://www.google.org/flutrends/.

3 Schaefer et al. 2011.

4 Gawande 2011.

5 Parry 2012.

6 The Economist Intelligence Unit 2013.

7 See Lanier 2010; see also Kakutani 2010.

8 Browne et al. 2013.

9 See European Commission, 2010a, b.

10 ITU 2013, Box 2.4.

11 The members of the Association of Southeast Asian Nations (ASEAN) are Cambodia, Indonesia, Laos PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

12 The six Gulf Cooperation Council states are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

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Appendix A: Structure and computation of the Networked Readiness Index 2014

This appendix presents the structure of the Networked Readiness Index 2014 (NRI). As explained in the chapter, the NRI framework separates environmental factors from ICT readiness, usage, and impact. That distinction is reflected in the NRI structure, which comprises four subindexes. Each subindex is in turn divided into a number of pillars, for a total of 10. The 54 individual indicators used in the computation of the NRI are distributed among the 10 pillars.

In the list below, the number preceding the period indicates the pillar to which the variable belongs (e.g., indicator 2.05 belongs to the 2nd pillar; indicator 8.03 belongs to the 8th pillar). The numbering of the indicators matches the numbering of the data tables at the end of the *Report*.

The computation of the NRI is based on successive aggregations of scores, from the indicator level (i.e., the most disaggregated level) to the overall NRI score (i.e., the highest level). Unless noted otherwise, we use an arithmetic mean to aggregate individual indicators within each pillar and also for higher aggregation levels (i.e., pillars and subindexes).[a]

Throughout the *Report*, scores in the various dimensions of the NRI pillars are reported with a precision of two decimal points. However, exact figures are always used at every step of the computation of the NRI.

Variables that are derived from the World Economic Forum's Executive Opinion Survey (the Survey) are identified here by an asterisk (*). All the other indicators come from external sources, as described in the Technical Notes and Sources section at the end of the *Report*. These variables are transformed into a 1-to-7 scale in order to align them with the Survey's results. We apply a min-max transformation, which preserves the order of, and the relative distance between, scores.[b]

NETWORKED READINESS INDEX 2014

Networked Readiness Index = 1/4 Environment subindex
+ 1/4 Readiness subindex
+ 1/4 Usage subindex
+ 1/4 Impact subindex

ENVIRONMENT SUBINDEX

Environment subindex = 1/2 Political and regulatory environment
+ 1/2 Business and innovation environment

1st pillar: Political and regulatory environment

1.01 Effectiveness of law-making bodies*
1.02 Laws relating to ICTs*
1.03 Judicial independence*
1.04 Efficiency of legal system in settling disputes*[c]
1.05 Efficiency of legal system in challenging regulations*[c]
1.06 Intellectual property protection*
1.07 Software piracy rate, % software installed
1.08 Number of procedures to enforce a contract[d]
1.09 Number of days to enforce a contract[d]

2nd pillar: Business and innovation environment

2.01 Availability of latest technologies*
2.02 Venture capital availability*
2.03 Total tax rate, % profits
2.04 Number of days to start a business[e]
2.05 Number of procedures to start a business[e]
2.06 Intensity of local competition*
2.07 Tertiary education gross enrollment rate, %
2.08 Quality of management schools*
2.09 Government procurement of advanced technology products*

READINESS SUBINDEX

Readiness subindex = 1/3 Infrastructure and digital content
+ 1/3 Affordability
+ 1/3 Skills

3rd pillar: Infrastructure and digital content

3.01 Electricity production, kWh/capita
3.02 Mobile network coverage, % population
3.03 International Internet bandwidth, kb/s per user
3.04 Secure Internet servers per million population
3.05 Accessibility of digital content*

4th pillar: Affordability[f]

4.01 Mobile cellular tariffs, PPP $/min.
4.02 Fixed broadband Internet tariffs, PPP $/month
4.03 Internet and telephony sectors competition index, 0–2 (best)

5th pillar: Skills

5.01 Quality of educational system*
5.02 Quality of math and science education*
5.03 Secondary education gross enrollment rate, %
5.04 Adult literacy rate, %

USAGE SUBINDEX

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

6th pillar: Individual usage

6.01 Mobile phone subscriptions per 100 population
6.02 Percentage of individuals using the Internet
6.03 Percentage of households with computer
6.04 Households with Internet access, %
6.05 Fixed broadband Internet subscriptions per 100 population
6.06 Mobile broadband Internet subscriptions per 100 population
6.07 Use of virtual social networks*

7th pillar: Business usage

7.01 Firm-level technology absorption*
7.02 Capacity for innovation*
7.03 PCT patent applications per million population
7.04 Business-to-business Internet use*[g]
7.05 Business-to-consumer Internet use*[g]
7.06 Extent of staff training*

8th pillar: Government usage

8.01 Importance of ICTs to government vision of the future*
8.02 Government Online Service Index, 0–1 (best)
8.03 Government success in ICT promotion*

IMPACT SUBINDEX

Impact subindex = 1/2 Economic impacts
+ 1/2 Social impacts

9th pillar: Economic impacts

9.01 Impact of ICTs on new services and products*
9.02 PCT ICT patent applications per million population
9.03 Impact of ICTs on new organizational models*
9.04 Employment in knowledge-intensive activities, % workforce

10th pillar: Social impacts

10.01 Impact of ICTs on access to basic services*
10.02 Internet access in schools*
10.03 ICT use and government efficiency*
10.04 E-Participation Index, 0–1 (best)

NOTES

a Formally, for a category i composed of K indicators, we have:

When two individual indicators are averaged (e.g., indicators 1.04)

$$\text{category}_i = \frac{\sum_{k=1}^{K} \text{indicator}_k}{K}$$

and 1.05 in the 1st pillar), each receives half the weight of a normal indicator.

b Formally, we have:

$$6 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 1$$

The *sample minimum* and *sample maximum* are, respectively, the lowest and highest country scores in the sample of economies covered by the GCI. In some instances, adjustments were made to account for extreme outliers. For those indicators for which a higher value indicates a worse outcome (i.e., indicators 1.07, 1.08, 1.09, 2.03, 2.04, 2.05, 4.01, and 4.02), the transformation formula takes the following form, thus ensuring that 1 and 7 still corresponds to the worst and best possible outcomes, respectively:

$$-6 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 7$$

c For indicators 1.04 and 1.05, the average of the respective scores is used in the computation of the NRI.

d For indicators 1.08 and 1.09, the average of the respective normalized scores is used in the computation of the NRI.

e For indicators 2.04 and 2.05, the average of the respective normalized scores is used in the computation of the NRI.

f The affordability pillar is computed as follows: the average of the normalized scores of indicators 4.01 mobile cellular tariffs and 4.02 Fixed broadband Internet tariffs is multiplied by a *competition factor*, the value of which is derived from indicator 4.03 Internet and telephony sectors competition index. It corresponds to the score achieved by an economy on this indicator normalized on a scale from 0.75 (worst) to 1.00 (best), using the min-max transformation described above. A normalized score of 0.75 is assigned to an economy with a competition index score of 0, which means that a monopolistic situation prevails in the 19 categories of ICT services considered. A normalized score of 1.00 is assigned to an economy where all 19 categories are fully liberalized. Where data are missing for indicator 4.03 (i.e., Puerto Rico and Timor-Leste), the score on the affordability pillar, which is simply the average of the normalized scores of indicators 4.01 and 4.02, is used. The competition index score for Taiwan, China, was derived from national sources.

g For indicators 7.04 and 7.05, the average of the respective scores is used in the computation of the NRI.

CHAPTER 1.2

The Internet of Everything: How the Network Unleashes the Benefits of Big Data

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Exabytes (10^{18}) of new data are created every single day. Much of this information is transported over Internet protocol (IP) networks. First described by Clive Humby as the "new oil,"[1] this data growth is fueling knowledge economies, sparking innovation, and unleashing waves of creative destruction. But most of these data are unstructured and underutilized, flowing at a volume and velocity that is often too large and too fast to analyze. If data do, in fact, comprise the new raw material of business, on par with economic inputs such as capital and labor,[2] then deriving insight and added value from this new input will require targeted transmission, processing, and analysis.

A rising share of this data growth is flowing over IP networks as more people, places, and things connect to this Internet of Everything (IoE). Proprietary networks, built on industry-siloed standards such as those in manufacturing or electric utilities, are increasingly migrating to IP networks, facilitating the growth of big data, and fast becoming the key link among data generation, processing, analysis, and utilization.

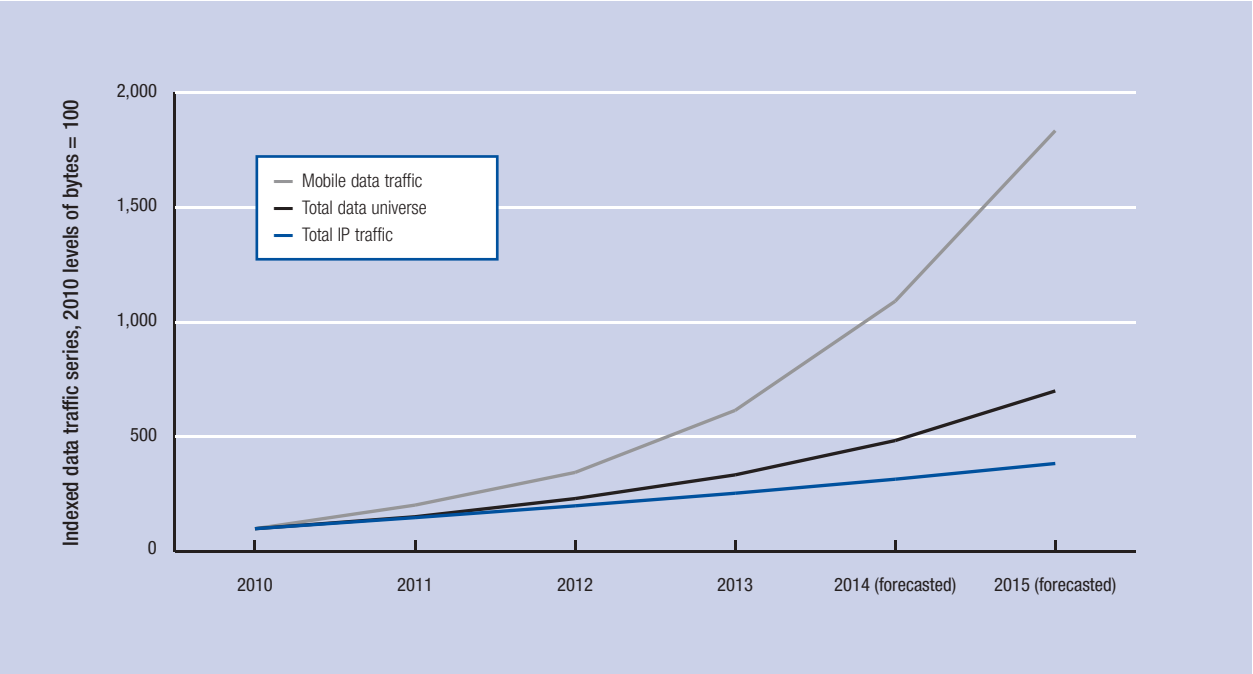
How can we effectively maximize value from this data explosion and avoid the pitfall of diminishing marginal data value? This chapter details how IP networks underpin the IoE and can accelerate big data's transformational impact on individuals, businesses, and governments around the world. After first highlighting four major trends driving data growth over IP networks and detailing how networks are central to maximizing analytical value from the data deluge, the chapter identifies critical technology and public policy challenges that could either accelerate or encumber the full impact of big data and the IoE.

ACCELERATING DATA PRODUCTION AND DATA TRAFFIC

Data growth is skyrocketing. Over 2.5 quintillion bytes of data are created each day; 90 percent of the world's stored data was created in the last two years alone.[3] To put this into context, one hour of customer transaction data at Wal-Mart (2.5 petabytes) provides 167 times the amount of data housed by the Library of Congress. The research consultancy IDC estimates that the digital universe—all digital data created, replicated, or consumed—is growing by a factor of 30 from 2005 to 2020, doubling every two years. By 2020, there will be over 40 trillion gigabytes (or 40 yottabytes) of digital data—or 5,200 gigabytes for every person on earth.[4]

Much of this data growth is traversing IP networks. Cisco's Visual Networking Index estimates that, from 2012 to 2017, total traffic over IP networks will grow threefold, rising at a compound annual growth rate (CAGR) of 23 percent. Mobile data traffic, however, is growing at an even faster pace: over the same period, mobile data will grow 13-fold, with a CAGR of 66 percent, capturing a greater share of all data created and transmitted (Figure 1).[5]

Figure 1: Growth rates and rising share of mobile data



Sources: Cisco 2013b; EMC² 2013; authors' calculations.

Despite the rapid growth in data production and transmission, however, only a small fraction of all physical objects in the world are currently connected to IP networks. Cisco estimates that less than 1 percent of physical objects are connected to IP networks.[6] But the IoE is expanding as more devices and users are connecting to IP networks every day, conducting more transactions and processes online.

For individuals, the impacts of the IoE are felt daily. Sensors embedded in shoes, for example, track the distances that fitness enthusiasts run and automatically upload information to social media profiles to immediately compare athletic achievements with those of friends. Internet-enabled alarm clocks gather data on weather and traffic, combining that information with a user's schedule, determining the optimal time to wake local residents. And applications on smart phones can control home electronic devices, adjusting heating and cooling levels as well as arming (or disarming) security settings remotely.

At an industrial level, applications using sensor technologies are capturing vast amounts of data to improve decision-making. Sensors embedded in agricultural fields monitor temperature and moisture levels, controlling irrigation systems. Devices in oil fields and deep well rigs track all aspects of drilling and fuel delivery, increasing production efficiency. And sensors in vehicles are able to monitor usage, informing decisions around refueling and repair as well as vehicle design.

For governments, IoE and big data applications are helping to monitor pandemics and environmental conditions, improve public safety and security, and increase efficiency in the delivery of public services such as municipal traffic systems that incorporate real-time remote monitoring to streamline traffic flows.

As more people, places, and things connect to the IoE, the data universe will continue to grow rapidly. The IoE will not only fuel the expansion of big data and data transmission, but can also provide targeted, automatic, data-driven analysis for our day-to-day lives.

CRITICAL DRIVERS OF DATA GROWTH

In 1944, the first digital computer, the Colossus, was deployed in the United Kingdom to decipher codes during World War II. The Colossus was able to process data at 5,000 characters per second (~25 Kb/s).[7] Currently the world's fastest supercomputer, the MilkyWay-2, can process 54,902 × 10^{12} operations per second (54,902 TFlop/s).[8] This intensive growth in data processing power continues today, coupled with extensive growth in data production. This data growth also supports four major trends that lead to a rising share of data transmission over IP networks in the world of the IoE, as described below.

- **Internet protocol (IP) is becoming the common language for most data communication.** Proprietary industrial networks are migrating to IP, bringing previously isolated data onto public and managed IP networks. The Internet's history is built on the migration of proprietary networks to IP. Proprietary data networks such as AppleTalk and IBM Systems Network Architecture (SNA) have migrated to IP over time, and traditional time-division multiplexing (TDM) voice networks are migrating to

Voice over Internet Protocol (VoIP). Today electricity grids, building systems, industrial manufacturing, oil systems, and a multitude of other sectors with networks that were previously built with proprietary protocols are increasingly migrating to IP as industries and enterprises recognize the value of interoperability and scale. Each migration shifts a large amount of data production and transmission onto IP networks (see Box 1).

- **Previously unconnected places, people, things, and processes are connecting to networks for the first time.** Billions of people and devices will come online in the next five years, adding heavily to the endpoints collecting data and to the devices consuming information. Cisco's Visual Networking Index estimates that, between 2012 and 2017, 7 billion more devices will connect to the Internet, reaching a total of 19 billion connected devices. These figures are conservative projections; other estimates of the total number of connected devices range from around 20 billion to 50 billion by 2020.[9] By 2017, nearly half of the world's population (3.6 billion out of 7.6 billion people) will be connected to the Internet. Of the world's total inhabited areas, mobile network coverage will increase to 85 percent in 2017, up from 79 percent in 2012.[10] In addition, a diversity of processes are migrating online. These include transactional activities (such as payments and requests), environmental monitoring (such as environmental sensors and remote monitoring), and government interactions (including census taking, tax collections, and benefit distributions).

- **Existing physically stored information is being digitized in order to record and share previously analogue material.** Over the last decade, the digital share of the world's stored information has increased from 25 percent to over 98 percent.[11] Information previously stored on other media—such as paper, film, and other analogue formats—is being digitized, along with meta-information about the data itself (e.g., descriptive statistics, frequency, distribution, dispersion, etc.). This digitization of information is leading to greater exchange of stored media and data over the Internet.

- **The introduction of Internet protocol version 6 (IPv6) allows for trillions of trillions (10^{38}) of devices to connect to the Internet.** IPv6 is the latest update to the protocol that underpins the Internet. It defines the system for routing traffic on the Internet by giving identification and location to all points connected to the global IP network. The previous version of the protocol, IPv4, enabled only approximately 4 billion IP addresses. But IPv6 provides more than 340 trillion, trillion, trillion, addresses,[12] ensuring no immediate exhaustion of IP

Box 1: Big data: Huge and growing data volume from industrial applications

Industrial applications of the Internet of Everything (IoE) generate immense data flows, which are increasingly shifting over to Internet protocol (IP) networks. One reason for the shift is that IP networks have increased reliability. Industrial networks have traditionally been concerned with uptime and latency, and IP networks have evolved to be able to handle industrial demands and the data flows that come with them.

In the oil and gas industry, for example, data are utilized across the entire value chain, from exploration, production, refining, and distribution to marketing and retail. Sensors and computing are used to capture and monitor seismic data, borehole activity, environmental readings, weather, production utilization, storage capacity, spot pricing (trading), transportation, inventory levels, demand and forecasts, and location data. In seismic exploration, the cost, size, and speed of data are all rising as exploration moves to 3D imaging. Data capture amounted to around 300 megabytes per square kilometer in the 1990s. By 2006, data per square kilometer amounted to 25 gigabytes, while today the amount per square kilometer is in the petabytes.[1] According to Chevron and industry-wide estimates, a "fully optimized" digital oil field based on data utilization results in 8 percent higher production rates and 6 percent higher overall recovery.[2]

In electric utility grids, data utilization also improves efficiency. Current grids monitor data to control electricity flows (both to and from the grid) based on real-time demand, thus improving generator efficiency and ensuring more-sustainable energy sources. Upgrading standard electric meters to "smart meters" allows information to be communicated over a network back to a control center and increases the amount of data captured. While traditional meters are read once a month, some smart meters can report usage rates in 15-minute intervals. For every million meters, this leads to 96 million measurements per day, an estimated 3,000-fold increase in data collection.[3] Conservative estimates of the total amount of data that will be generated by smart meters by 2019 in the United States alone (assuming only two readings per day, and below full deployment) yields measurements in the order of hundreds of petabytes per year.[4]

In an example from another industry, aircraft manufacture and operation, sensors on General Electric (GE)'s jet plane turbines illustrate the vast amount of data generated daily. GE estimates that each sensor on a GE turbine generates approximately 500 gigabytes of data every day. Each turbine has 20 sensors, and globally GE owns approximately 12,000 turbines. This aggregates to petabytes of data daily.[5]

Notes

1 Beals 2013; see also note 4 at the end of this chapter.

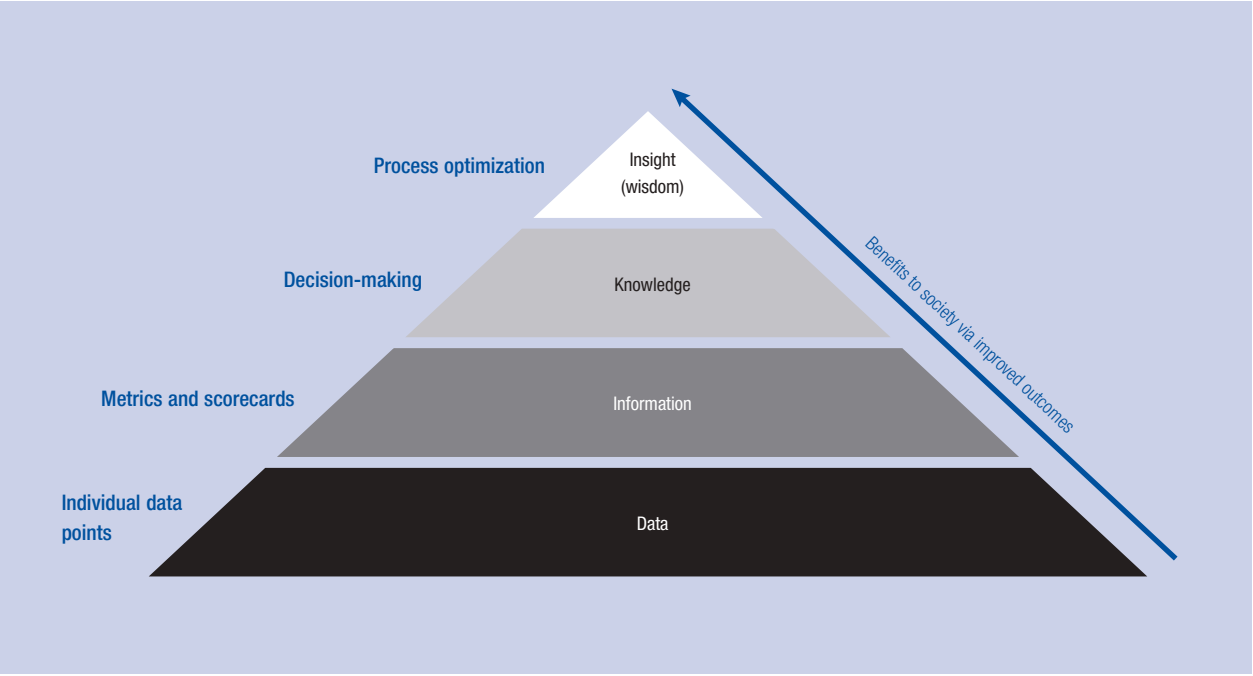
2 Leber 2012.

3 IBM Software 2012.

4 Danahy 2009; Fehrenbacher 2009.

5 Lopez 2013.

Figure 2: Turning data into insight



Sources: Ackoff 1989; authors' interpretation.

addresses or limits to the number of IP connections. The sheer number of available addresses allows for every single star in the known universe to have 4.8 trillion addresses.

THE GAP BETWEEN DATA GROWTH AND DATA VALUE

Current estimates suggest that only half a percent of all data is being analyzed for insights;[13] furthermore, the vast majority of existing data are unstructured and machine-generated.[14] Applying analytics to a greater share of all data can lead to productivity increases, economic growth, and societal development through the creation of actionable insights.

Data alone are not very interesting or useful. It is when data can be used and become actionable that they can change processes and have direct positive impact on people's lives. The IoE generates data, and adding analysis and analytics turns those data into actionable information. Building on the framework of the knowledge hierarchy,[15] aggregated data become information that, when analyzed, become knowledge. Knowledge can lead to insights and informed decision-making, which at the highest level is wisdom (Figure 2).

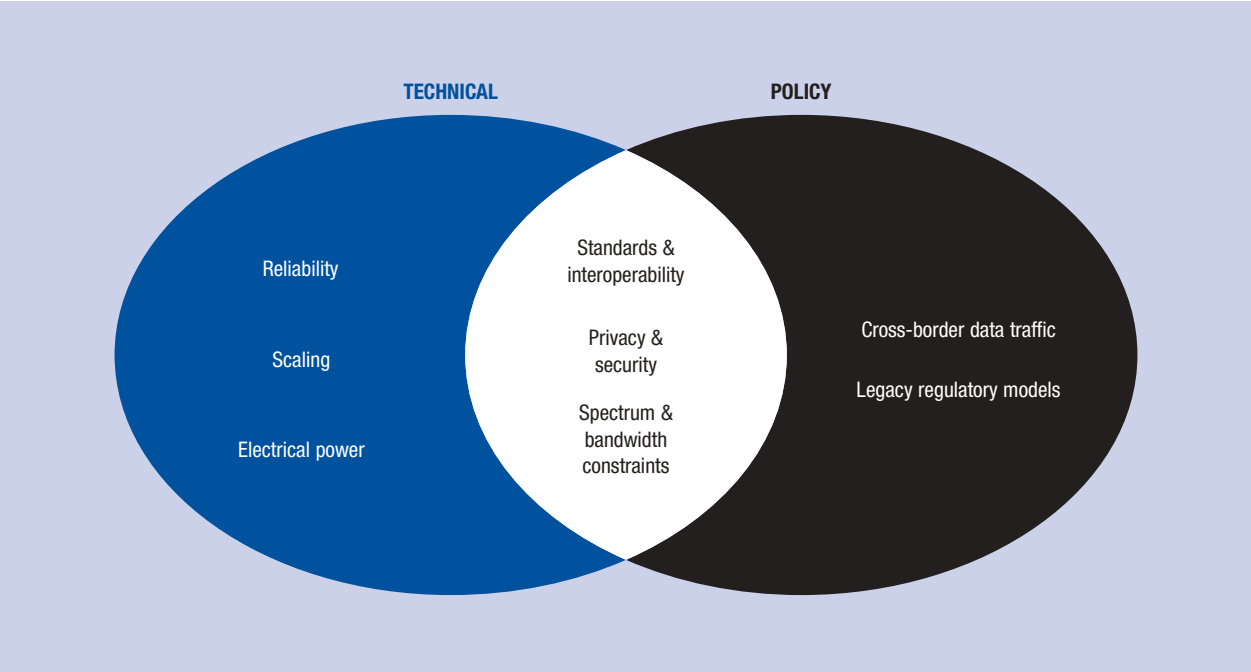
For example, society at large can benefit from tracking trends observed from metadata such as anonymized mobile phone data used to track population migration after the earthquake and cholera outbreaks in Port-au-Prince, Haiti.[16] Likewise, analyzing social media discussions can identify crises or flu outbreaks.

At an industrial level, big data analysis can yield very large benefits. For example, the value of modernizing the US electricity grid to be data-driven is estimated at US$210 billion. A reconstituted electricity grid would be based on an architecture driven by "technology selections to fully harness the convergence of data, controls and transactions."[17]

According to Bradley et al. in a recent Cisco White Paper, harvesting data for critical decision-making though the IoE can create approximately US$14.4 trillion dollars of added value in the commercial sector over the next 10 years across a wide range of industries.[18] This opportunity exists in the form of new value created by technology innovation, market share gains, and increasing competitive advantage. It translates into an opportunity to increase global corporate profits by approximately 21 percent, driven by improvements in asset utilization (reducing costs and improving capital efficiency), employee productivity (improved labor efficiency), supply chain logistics (eliminating waste and improving process efficiency), customer experience (adding more customers), and innovation (reducing time to market).

Similarly, research by the Economist Intelligence Unit and Capgemini indicates that big data analytics were responsible for a 26 percent improvement in business performance among a cohort of companies examined, and forecasts that the impact could increase to 41 percent in three years.[19] Capturing these gains, however, may require concurrent investment in resources to manage the rise in data. It is forecasted that by 2020, an average business will have to manage 50 times more information than it does today, while the average information technology (IT) staff is expected to rise only by 1.5 times.[20]

Figure 3: Policy and technical issues facing big data and the IoE



Source: Authors.

EQUIPPING IP NETWORKS TO DELIVER BIG DATA INSIGHTS

Moving up the knowledge pyramid from data to insights and informed decisions is a critical challenge facing businesses and governments. Equipping IP networks to better transmit data to processing centers as well as enabling the network to create, analyze, and act on data insights is one comprehensive approach. Building this capability will require improving network infrastructure, building analytical capabilities and "intelligence" into the network, and distributing computing and analytical capabilities throughout the network, particularly at the edge. Specifically, these are:

- *Network infrastructure improvements.* These improvements include connecting all things, including unintelligent ones (those that are capable only of transmitting data, not receiving them); securing infrastructure; improving inter and intra-data center traffic flows; and increasing the ability to manage private and public networks.
- *Building intelligence into the network.* This will require building in the ability to compute data in motion and host partner applications in an ecosystem where applications can be built to analyze data inflow, particularly enabling machine-to-machine (M2M) services.
- *Distributing computing and storage.* Efficient distribution will require moving the ability to analyze data only in the data center to add processing at the edge (or near the edge) of the network, to prevent delays in processing caused by latency as well as delays caused by network congestion.

TECHNICAL AND POLICY CHALLENGES

Building a network that will maximize the impact of big data requires powerful and seamless interactions among sensors, devices, computing, storage, analytics, and control systems.

But although IP networks are primed to support the expansion of big data and the IoE, technical and policy challenges exist in the ability of current IP networks to fully exploit big data expansion (Figure 3). An approach that tackles these issues concurrently will help to create the right ecosystem. The discussion below highlights specific issues that will need to be addressed thoughtfully.

Standards and *interoperability issues* span both the technical and policy domains. Agreement on standards is critical to develop economies of scale by encouraging product and service innovation around a common language, and generally accepted global standards allow for greater interoperability between devices. Requirements differ for closed critical networks (such as utilities) and open networks (for example, those that may monitor parking space availability), but common standards allow information to be exchanged within, and among, these networks when those needs arise.

Privacy issues arise with the growth of data, particularly with regard to data generated by or about individuals. Policymakers must identify the appropriate balance between protecting the privacy of individuals' data and allowing for innovation in service delivery and product development. New technologies and services,

such as location-based services, are bringing these privacy issues to the forefront, offering users enhanced experiences while raising concerns of identity protection. Some policies—such as transparency in the use of data and effective mechanisms for consumer control of personal data—can help in this regard. The key *security issues* for big data include the reliable prevention of hacking and access by unauthorized and unwanted users to large databases and data flows. In order to ensure a healthy ecosystem where users, consumers, and businesses feel safe in engaging in big data activities, network security is essential.

Over the next five years, the growth of mobile data traffic will require greater radio spectrum to enable wireless M2M, as well as people-to-people (P2P) and people-to-machine (P2M), connectivity. Ensuring device connectivity and sufficient bandwidth for all of the uses of wireless sensors will require careful planning. The spectrum requirements are going to be heterogeneous and will include narrowband and broadband frequencies, short haul and long haul spectrum, continuous data transmission and short bursts of data transmission, and licensed spectrum in addition to license-exempt spectrum. *Bandwidth constraints* will also be an obstacle in transmitting data over existing networks. The examples cited in Box 1 reflect the volume of data being generated by proprietary networks, resulting in the need to move computing close to the network edge in a distributed intelligence architecture. Data loads will be lumpy across various applications of the IoE, and matching bandwidth needs to bandwidth availability will be a continuous challenge.

As more critical processes are conducted as part of the IoE, the need for *reliability* in IP networks increases. Healthcare applications that require instant communication between end users and medical professionals, safety and security applications, utility functions, and industrial uses are examples where continuous, uninterrupted, real-time communications require reliable and redundant connectivity. Low latency (the time required for round-trip data transmission) is already required for advanced cloud computing applications such as high-definition video conferencing and industrial collaboration. Any interruption to the transmission of data over networks negatively impacts these processes.

Constraints on the technological limits of electrical efficiency and on computer memory and processing already pose *limits to computing* and data analysis. Data centers, for example, exemplify the boundaries where electrical power, cooling resources, and space design are constantly redesigned and re-imagined to advance current capabilities. As the IoE expands into tens of billions of connected devices, the technological aspects of IP networks have to be able to manage the huge scale of device connectivity. One aspect of this expansion, Internet addressing, is being resolved with the migration from IPv4 to IPv6. Other challenges include determining how virtualized computing environments may support a reallocation of computing resources. And new sources of electrical power (advanced batteries, simple chemical reactions, etc.) will be needed to power the multitude of new devices that will emerge.

IoE applications that collect and handle data across sovereign jurisdictions could be negatively affected by policies restricting *cross-border data traffic and global trade* in IoE-related services. Emerging cross-border issues include national data protection rules and data transfers, data portability and interoperability standards, and liability costs for cloud service providers. Furthermore, trade in some IoE services may fall under existing international trade agreements, while others do not.

As the IoE permeates across business sectors, the application of IoE technology in traditional industries presents new challenges to *legacy regulatory models.* IoE technology is impacting business models, input/output markets, and end users in markets ranging from healthcare to utilities. The heavily regulated energy markets, in particular, face a range of issues from "connected energy" technologies. At the consumer level, smart meters may present privacy and security challenges. However, at the aggregation and distribution levels, utility companies face the new reality of a changing energy source mix and must adapt to transactional loads and markets along with existing grid control that needs to adapt to distributed intelligence as well as challenges to traditional regulated utility pricing.

THE CENTRALITY OF THE NETWORK

Since the beginning of our species, humans have been processing data. We have been our own primary data machines. But today, with the advent of vast arrays of computing power, we increasingly rely on data processed by others, and the IoE and the era of big data are transforming our lives.

Data flows and the ability to capture value from data are changing industries, creating new opportunities while impacting others. For example, the "app economy"—the business created by software applications running on smartphones—has created hundreds of thousands of jobs.[21] One recent study estimates that the marginal impact of data utilization in the IoE could raise US gross domestic product by 2 percent to 2.5 percent by 2025.[22]

The IoE—where more data are being captured by more devices, interacting with more people and changing the processes by which we live, learn, work, and play—is having a profound impact on the world. But the value derived from the IoE can be measurably increased if IP networks are able to facilitate the rise of big data and generate added positive impact for society.

NOTES

1 Palmer 2006.

2 The Economist 2010.

3 IBM 2013.

4 Gantz and Reinsel 2012. A useful reminder in the sequence of data storage and memory is that the measure increases by the thousands and the sequence is from byte, kilobyte, megabyte, gigabyte, terabyte, petabyte, exabyte, zettabyte and beyond.

5 Cisco 2013b

6 Cisco 2013a.

7 McLellan. 2013.

8 Top500.org 2013.

9 Biggs et al. 2012.

10 GSM Association 2012.

11 Cukier and Mayer-Schoenburger 2013.

12 More specifically, 340,282,366,920,938,463,463,374,607,431,768, 211,456 addresses, or roughly 3.4 times 1038.

13 Gantz and Reinsel 2012.

14 Canalys 2012.

15 Ackoff 1989.

16 Bengtsson et al. 2011.

17 De Martini and Von Prellwitz 2011; Taft et al. 2012, p. 2.

18 Bradley et al. 2013.

19 EIU 2012.

20 EMC^2 2013.

21 In the United States, according to Mandel and Scherer (2012), over 500,000 jobs have been created through application development since 2007; in the European Union, Vision Mobile and Plum (2013) found that nearly 800,000 jobs have been created this way.

22 Mandel 2013.

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CHAPTER 1.3

Big Data Maturity: An Action Plan for Policymakers and Executives

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The total volume of structured and unstructured data generated by individuals, enterprises, and public organizations is multiplying exponentially; 90 percent of the total data stored today is less than two years old.[1] So-called big data has the potential to improve or transform existing business operations and reshape entire economic sectors. It can also pave the way for disruptive, entrepreneurial companies and allow new industries to emerge.

THE BIG DATA IMPERATIVE

If they are to capitalize on this potential, organizations should avoid a common misapprehension. Much debate has focused on the need to develop the technology to store and analyze the deluge of data that threatens to drown companies. Although this technology is indeed necessary, it is not sufficient to enable big data to be exploited fully.

Organizations must instead remold their decision-making culture so that senior executives make more judgments based on clear data insights rather than on intuition. They must build the necessary internal capabilities, deploying the technical and human resources to interpret data in an astute manner. Moreover, because they rely on governments to provide the requisite environment, they must ask policymakers to create the regulatory framework and information and communications technology (ICT) infrastructure to remove external obstacles.

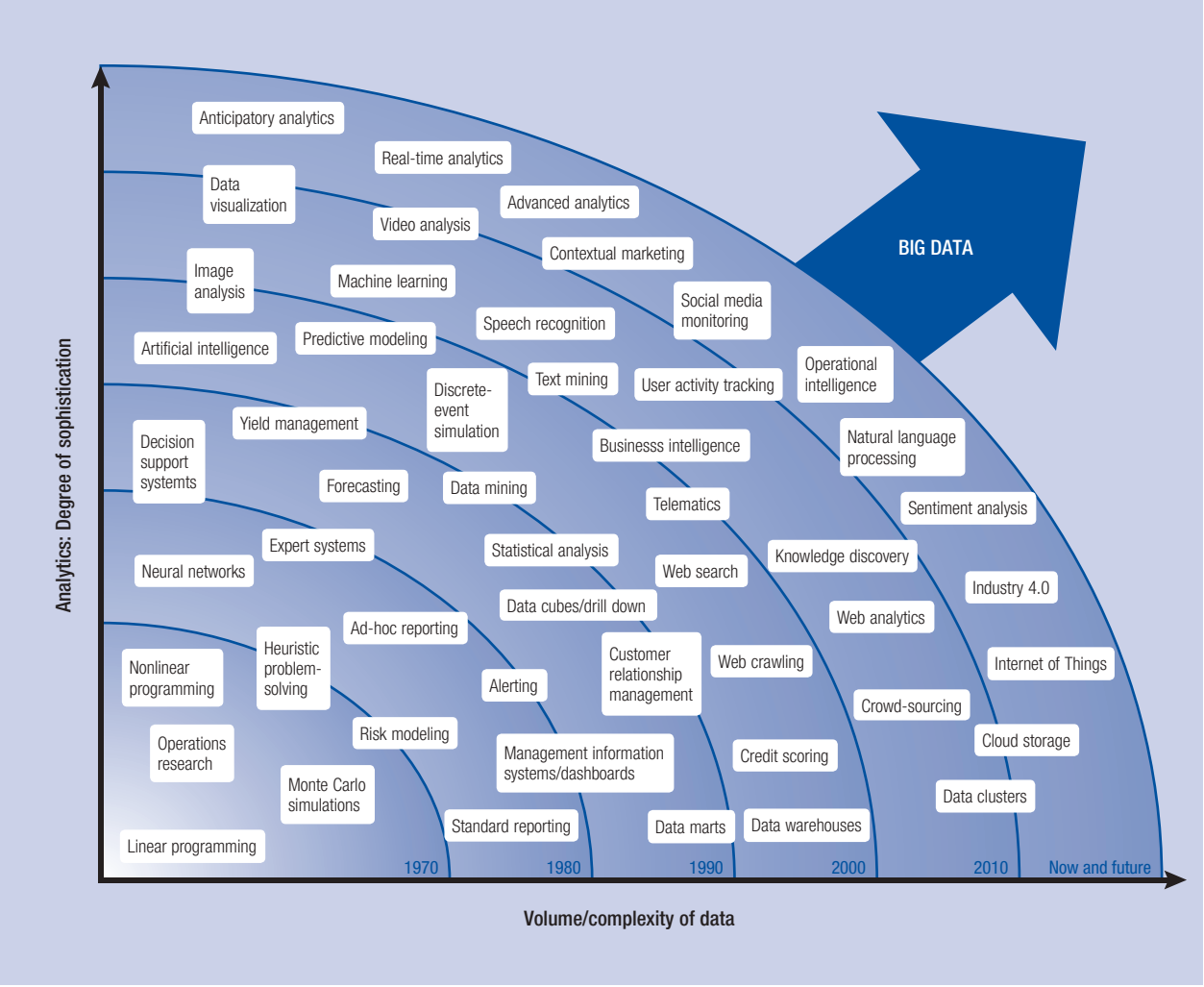
We propose a Big Data Maturity Framework that is based on the experiences of organizations that have undergone a big data transformation. This framework will allow organizations to assess their progress in this arena and determine what they need to do to extract greater business and organizational benefits from the vast volume of data. The framework incorporates three elements: (1) environment readiness; (2) internal capabilities; and (3) the various, steadily more sophisticated, ways to use big data that range from increased efficiency in existing operations to a complete change in an organization's business model.

WHAT IS BIG DATA?

Big data represents the newest and most comprehensive version of organizations' long-term aspiration to establish and improve their data-driven decision-making. It is characterized by what are known as the "three Vs"—large data *volumes,* from a *variety* of sources, at high *velocity* (i.e., real-time data capture, storage, and analysis). Besides structured data (such as customer or financial records), which are typically kept in organizations' data warehouses, big data builds on unstructured data from sources such as social media, text and video messages, and technical sensors (such

The authors wish to thank Dr. Andreas Deckert for his contribution to this chapter.

Figure 1: Evolution of data-driven decision-making



Source: Booz & Company.

as global positioning system, or GPS, devices)—often originating from outside the organization itself.

The magnitude and complexity of data being produced far exceed the typical capacities of traditional databases and data warehouses for the purposes of storing, processing, analyzing, and deriving insights. Usage statistics emanating from social media sites illustrate the sheer volume of unstructured data. For example, in 2012 Facebook reported that it was processing around 2.5 billion new pieces of content daily.[2]

Big data has the potential to infuse executive decisions with an unprecedented level of data-driven insights. However, research indicates that many organizations are struggling to cope with the challenges of big data. For example, in 2012 the Aberdeen Group found that the proportion of executives who reported that their companies were unable to use unstructured data, and who complained that the volume of data was growing too rapidly to manage, had increased by up to 25 percent during the previous year.[3]

EVOLUTION, NOT REVOLUTION

Despite the rapid growth of big data, organizations should keep its influence in perspective. Although remarkable, the big data phenomenon is merely the continuation of a journey in which ever-more-elaborate data have influenced decision-making. From organizations' first attempts at data analytics in the 1960s and 1970s, this journey has proceeded through various stages, described by buzz words such as *data mining* and *business intelligence,* all of which sought to transform raw data into meaningful information for business purposes (Figure 1).

The latest development, big data, may appear all-enveloping and revolutionary. However, the essential principles for exploiting its commercial benefit remain exactly the same as they were in previous moves toward increased data-driven decision-making. Executives must harness this recent data explosion by focusing on carefully formulating the business questions that enable the swift and accurate identification of those nuggets of data that they believe can improve their organization's

performance or allow them to gain access to new revenue pools.

This continuation of a trusted managerial approach does not, however, imply an endorsement of inertia. Rather, organizations must foster a new decision-making culture to exploit the opportunities presented by big data and prepare their own internal capabilities to handle this new era. At the same time, they must encourage governments to nurture an environment conducive to the exploitation of big data.

THE BUSINESS IMPACT OF BIG DATA

Many organizations are still in the early stages of reaping the benefits of big data. Writing in the *Harvard Business Review,* Andrew McAfee and Erik Brynjolfsson explored the impact of big data on corporate performance. The authors interviewed executives in 330 publicly traded companies in the United States. They then examined relevant performance data, enabling them to measure the extent to which corporate attitudes toward big data correlated with how the respective companies were faring.

McAfee and Brynjolfsson's conclusions were remarkable for establishing a connection between big data and performance: "The more companies characterized themselves as data-driven, the better they performed on objective measures of financial and operational results." The advantage gained by these companies over their rivals was also marked: "In particular, companies in the top third of their industry in the use of data-driven decision-making were, on average, 5 percent more productive and 6 percent more profitable than their competitors."[4]

Despite these findings, broad adoption of advanced big data practices has not yet materialized. A 2013 Gartner survey found that less than 8 percent of companies surveyed have actually deployed big data technology.[5]

Investment in forthcoming projects is much more widespread; the research firm IDC has forecasted that the market for big data technology and services will reach US$16.9 billion by 2015, up from US$3.2 billion in 2010. This represents a 40 percent annual growth rate, seven times the rate for the overall ICT business.[6] This trend is affecting all regions. For example, over 40 percent of chief information officers in the Middle East, according to IDC, are considering big data technology investment in 2013. Although few have actually undertaken large-scale big data or analytics programs to date, IDC forecasts investment in this area to grow at a compound annual growth rate of over 20 percent over the coming five years.[7]

Both expenditure and implementation vary substantially across regions, industries, and functional domains. For example, highly digitized industries such as telecommunications and travel still tend to spend substantially more on big data projects than the energy sector, and there is far more implementation of big data initiatives in the United States than in the Asia Pacific region. Meanwhile, the Economist Intelligence Unit found that big data is most frequently enlisted to assist financial management and marketing/sales, and deemed least valuable in human resources management.[8]

How big data is used

The big data maturity stages (Figure 2) depict the various ways in which data can be used, from selective adoption to large-scale implementation. Depending on the maturity of an organization's big data capabilities, big data can significantly increase top-line revenues and markedly reduce operational expenses. The path to business model transformation, the highest level of maturity, promises potential high returns but often involves major investment over many years.

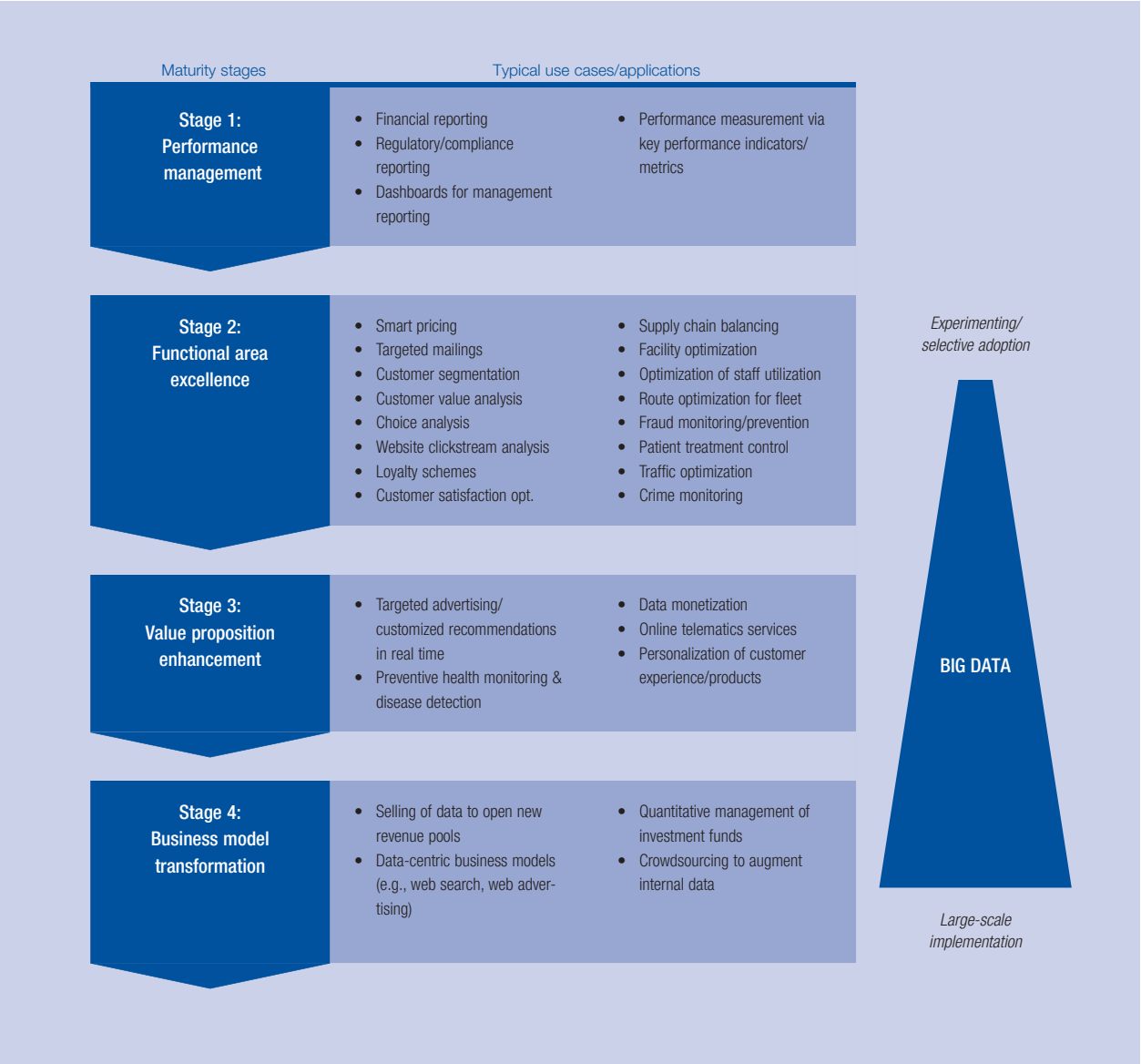
The first maturity stage, performance management, enables executives to view their own business more clearly through, for example, user-friendly management information dashboards. This stage typically relies on internal data, with an organization establishing key performance indicators (KPIs) to evaluate its success at achieving stated goals.

During stage 2, functional area excellence, organizations start to experiment with internal and external data to improve selected facets of their business. This may involve sales and marketing techniques such as customer segmentation and targeting, or entry-stage analytical methods for product recommendations. For example, one retailer analyzed data recounting the past purchasing behavior of individual customers in conjunction with the company's most recent sales to predict and recommend each customer's most likely next purchase. This resulted in a revenue increase of up to 5 percent, depending on the customer segment.

Advances in operational efficiency through big data, such as the efficient deployment of staff resources and the optimization of the supply chain, also reside within this maturity stage. Recent examples include a German car manufacturer that used real-time performance monitoring of production machinery to trigger a 20 percent increase in productivity. Each machine was tightly monitored to highlight downtime and plan around those production disruptions to optimize the utilization of the overall plant. In the public sector, a Canadian hospital observed previously unseen patterns in streaming data from monitoring of newborns, enabling detection of dangerous infections 24 hours before symptoms appeared.[9]

At the value proposition enhancement stage (stage 3), organizations start to monetize big data, positioning it as a value driver of the business that offers a new source of competitive advantage beyond the mere improvement of operations or services. In many instances this involves obtaining data from external sources and

Figure 2: Big data maturity stages and related use cases



Source: Booz & Company.

deriving insights from it. This may include innovations such as customized, real-time recommendations or the personalization of services to augment the customer experience.

For example, one leading European bank tailored its website content to trigger an increase of 12 percent in sales. After customers logged in, the bank presented one of several alternative websites based on the relevant individual's transaction history and segment and the company's overall product portfolio. The content was specific to the predicted needs of the customer to maximize sales potential.

Data-rich organizations, such as retailers or telecommunications companies, are better equipped than others to utilize their internally generated data in this way. For instance, a global mass merchant was able to increase its profit per customer by 37 percent by applying advanced customer analytics, such as behavioral segmentation, to identify its best customers and provide them with personalized offers. The frequency of those target customers' purchases rose by approximately 25 percent, and the average basket size increased by around 10 percent.

Another instructive case involved the US city of Los Angeles, which introduced demand-responsive pricing for parking. The city sets specific prices for hourly parking in each street, varying according to the time and day. These prices are based on in-depth choice modeling, fed with data from parking sensors, surveys, weather forecasts, information about holidays, local business activities, and other information. The goal is to reach a steadily high, but not excessive, utilization

of parking space at all times. The initial results are impressive. Although city parking revenues increased by 2.4 percent due to higher utilization, 60 percent of parking rates actually fell and congestion during peak hours decreased by 5 percent.[10]

In the final maturity stage, business model transformation, big data permeates the whole organization. It becomes deeply embedded within the operation, determining the nature of the business and the mode of executive decision-making.

This stage can be reached by both product and services organizations alike. One example of the latter involves the recent merger of the two large advertising companies Omnicom and Publicis. Their industry is moving away from the creative "Mad Men" approach, where a catchy phrase was the pinnacle of aspiration, toward a more science-based, data-driven business that aims to personalize ads. The ultimate goal is to deliver the right message to the right person at the right time. The Internet and mobile devices play a major role in this development. This new "ad tech" world will be dominated by those major players that possess the most comprehensive data about consumers and are thus able to understand them better—who they are, where they are, what they like, who their friends are, and so on. Omnicom and Publicis believe that their combined size will produce the desired volume of data.

General Electric (GE) provides a prominent example of a product organization placing great faith in big data. GE expects that machinery and equipment will soon be loaded with sensors, making in-depth status data available both in real time and across longer time spans. To be at the forefront of this development, GE is investing more than US$1 billion in building up its data science capabilities to provide data and analytics services across business functions and geographies.[11]

Another showcase for the transformative potential of big data comes from the public sector. Regional and national-level policymakers around the world are launching "open data" initiatives, making data available to the public via integrated web portals and automated interfaces. Recent examples involve the United Kingdom and New York City.[12] Although originally conceived as a way of increasing the transparency of government decisions, the release of public data is an important environmental factor enabling organizations to use big data, creating novel applications and services.

However, some organizations do not have to progress through all the big data maturity stages. A data-driven business model has been integral to companies such as Google, Facebook, and Twitter, which have burst on to the scene in recent years and are introducing new technologies to capture the digital advertising market. Such companies actually started operations at the final stage. By doing so, they have prompted others to proceed through the earlier stages to keep up.

Obstacles to progress

Despite widespread interest in data-driven decision-making in one form or another, companies face many potential pitfalls in extracting the maximum commercial benefit from big data usage. Some of these relate to their own internal systems and culture; others are tied to the external environment.

The most prominent obstacle is the shortage of available talent specializing in data analytics—data scientists with an advanced education in mathematics or statistics who are also able to translate raw data material into exploitable commercial insights. Although many educational institutions have now started to establish courses to address this scarcity, the market demand is already considerable.

Many organizations also suffer from poor-quality data that are fragmented across various systems, geographies, and functional silos. Embracing the potential of big data as a concept will take organizations only so far. First and foremost, they must get the basics right. Internal data has to be of high quality—consistent, accurate, and complete—and available across the organization.

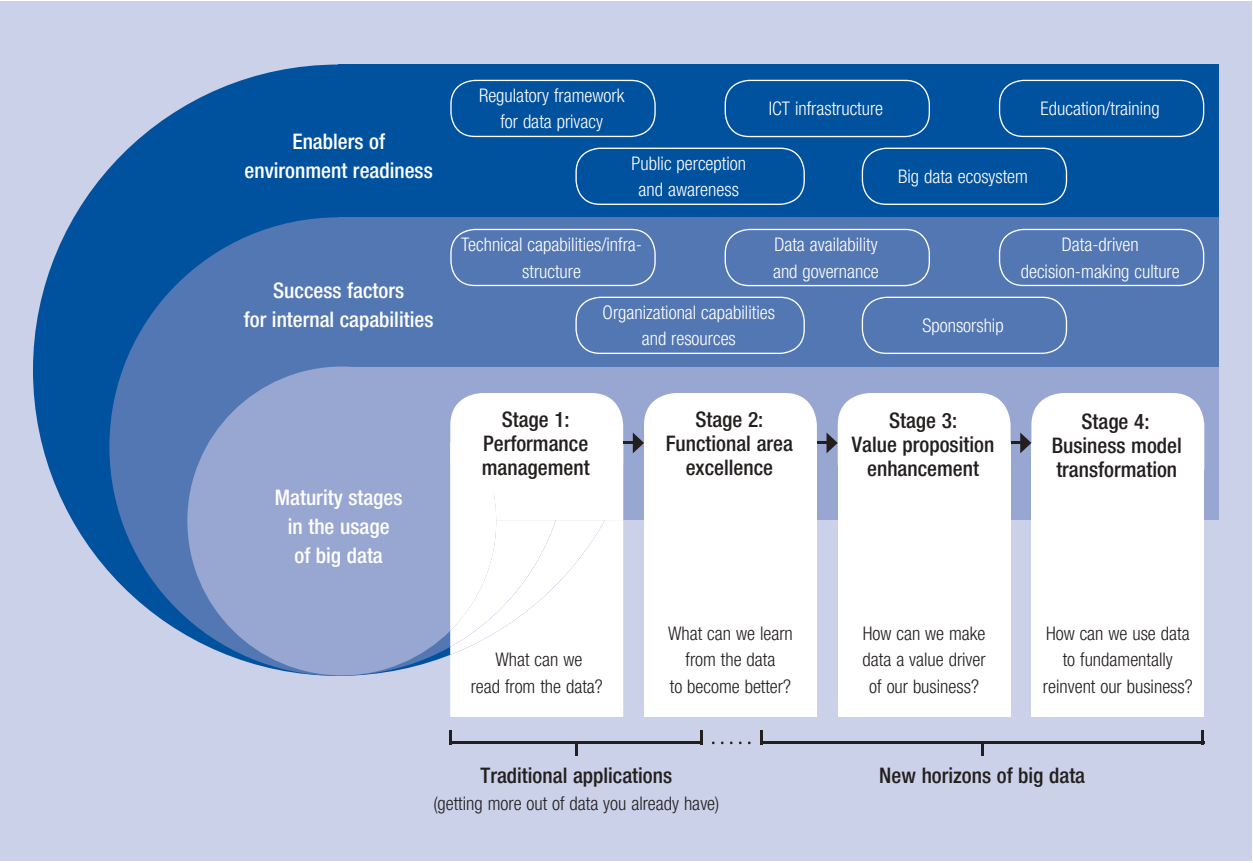
The prevailing decision-making culture presents a major internal obstacle—the one that is the least straightforward to identify and then overcome. To complicate matters, changing this culture may impinge on personal concerns relating to status. Companies and public institutions typically rely on the intuition of senior managers for important decisions. As big data extends its reach, executive instinct is challenged by the facts of hard data. However, while data can be of great assistance in solving an actual problem, it still holds true that senior management has to ask the right questions.

Many of the external challenges that companies face revolve around data privacy considerations. For example, very specific details of an individual's lifestyle preferences and buying habits are now captured and analyzed by companies through their own websites or by monitoring social media. These details are all collected without that person's explicit consent, leading to significant public reservations about big data. Such concerns about privacy will strengthen demands for tighter regulatory control, potentially limiting companies' ability to exploit big data opportunities or exposing them to threats of legal and regulatory intervention.

HOW TO REACH BIG DATA MATURITY

Our big data maturity framework (Figure 3) comprises three elements: the enablers of environment readiness, the organization's internal capabilities, and the different stages of maturity and sophistication in which big data can be used. The framework enables organizations to view the extent of their success in overcoming obstacles, and identifies what more can be done to promote big data maturity and reach the desired destination.

Figure 3: Big data maturity framework



Source: Booz & Company.

The environment readiness dimension considers how far the relevant governments have enabled organizations in their jurisdiction to use big data freely and productively. This is achieved through appropriate regulations and a supportive infrastructure.

The organization's internal capabilities dimension sheds light on a company's readiness to execute big data. By building up these capabilities and integrating them effectively, organizations move further along the path of data-driven decision-making and position themselves to extract greater benefits from big data.

While environment readiness serves as an enabler for big data usage, internal capabilities act as critical success factors for organizations seeking to progress through the maturity stages.

The following two sections explain the full range of actions that governments and organizations need to undertake and which of these take precedence.

Environment readiness: Priorities for policymakers

Big data will soon become ubiquitous practice in both the public and private worlds. Policymakers therefore need to act in a timely manner to promote an environment that is supportive to organizations seeking to benefit from this inevitable progression. Failure to develop comprehensive environment readiness carries the risk of losing competitive advantage vis-à-vis other countries.

Policymakers must therefore:

- formulate a vision for the usage of data consistent with the public interest, fostering a common understanding with citizens and obtaining their buy-in;
- enable a big data ecosystem by establishing policies to facilitate valid business models for third-party data, service, and information technology system providers; and
- speed and scale up the education of talent to address the likely significant shortage of talent with the requisite skills to leverage and handle big data—from both a business and an IT perspective, potentially in public-private partnerships (PPPs). Such PPPs can avoid having students in tailored university programs graduate with outdated learning by fostering and exploiting private contributions to the educational agenda. PPPs can involve public sponsorship of private education programs, and private support for university education in terms of knowledge transfer and financial endowments.

Priorities for policymakers will vary in different parts of the world. Developing countries, for example, will concentrate on building up the required ICT infrastructure and education programs to prepare for large-scale demand from organizations intent on using big data. In more developed countries, however, the government's primary concerns should be ensuring transparent regulation and promoting a public-interest argument for big data.

Policymakers must make the case for big data

In particular, policymakers should set clear rules regarding data privacy so that organizations know which personal data they can store and for how long, and which data are explicitly forbidden by privacy regulations.

If the scope of permissible data is to expand, skeptical citizens must first be persuaded that big data will work in their favor by paving the way for better products and services. Forward-thinking governments will initiate and inform this public debate about the benefits of big data. Indeed, Jules Polonetsky and Omer Tene, in their *Stanford Law Review* article (2013), argue that finding the right balance between individuals' legitimate privacy concerns and the overall rewards offered by big data practices may be the greatest contemporary public policy challenge.[13]

The outcome of this debate will vary depending on the country. Cultural factors will have a strong bearing on the decision about the right level of data privacy in any given country, and this decision will result in a regulatory regime appropriate for citizens and organizations. On a regional level, groups such as the European Union allow possible harmonization of data privacy regulation across borders, given that the constituent countries may share attitudes on this issue.

Policymakers should promote harmonization

On a global level, though, no binding agreement to harmonize regulation around data privacy currently looks likely in the short to medium term. Because countries have legitimate differences on this issue, this lack of harmonization threatens the adoption of big data on an international scale.

The prevailing patchwork situation accentuates the lack of clarity on lawful data usage—especially the question of which jurisdiction holds sway for certain cross-border cases. For example, if data are owned by a company in the European Union, but hosted on servers in the United States, which privacy law applies? Legal inconsistency between countries can even inhibit free commerce across borders. This problem arises, for example, when an organization plans to outsource data operations to a foreign provider, yet some personal data are prohibited from being transferred out of the country concerned.

The Organisation for Economic Co-operation and Development (OECD) *Guidelines on the Protection of Privacy and Transborder Flows of Personal Data,* which were revised and updated in 2013, may represent a practical step in the direction of harmonization.[14] In the absence of binding rules, a common understanding for data privacy and data protection regulation on the basis of guidelines and recommendations from a high-profile international organization is the most sensible option currently available.

The OECD guidelines follow a best-of-breed approach. They formulate basic principles around the limitation of collection of personal data, the specification of the purpose of data collection, the protection of collected data, the prevention of data loss or unauthorized access, and the right of individuals to obtain information about collected data. The guidelines have in the past influenced national legislation, including privacy acts in Australia, Japan, Mexico, and New Zealand. We encourage both OECD members and non-members to review and adopt those basic principles and recommendations to establish common ground.

An organization's internal capabilities: Priorities for executives

There is no general rule dictating how organizations should navigate the stages of big data maturity. They must each decide for themselves, based on their own situation—the competitive environment they are operating in, their business model, and their existing internal capabilities. In less-advanced sectors, with executives still grappling with existing data, making intelligent use of what they already possess may have a substantial impact on decision-making.

The main priorities for executives are to:

- develop a clear (big) data strategy;
- prove the value of data in pilot schemes;
- identify the owner for "big data" in the organization and formally establish a "Chief Data Scientist" position (where applicable);
- recruit/train talent to ask the right questions and technical personnel to provide the systems and tools to allow data scientists to answer those questions;
- position big data as an integral element of the operating model; and
- establish a data-driven decision culture and launch a communication campaign around it.

Quick wins

Organizations should resist expensive upfront infrastructure investments for overly ambitious big data projects. Instead, they should select opportunities for high business impact and adopt pilot schemes that also allow for periodic refinements along the way.

Seeking out proprietary data that can be immediately exploited for commercial gain may provide

one such quick win. For example, a mobile phone operator can collect anonymized real-time travel patterns, which are of value for navigation system operators that want to provide up-to-date traffic information to their customers.

Help from outside

External data providers can offer all types of data to organizations and can therefore complement existing data-gathering efforts. Typical datasets offered by external providers include contact, lifestyle, and demographic information on (market segments of) individuals. Social media platforms are also demonstrated to be great sources of relevant big data—for example, for sentiment analysis (to determine the voice and desires of the consumer) or for personalizing product offerings. In addition to sourcing data from outside the organization, the selective use of external analytics service providers can also prove instrumental in establishing big data maturity quickly, while potentially training employees to take on these tasks themselves.

CONCLUSION

We currently see big data as poised to have significant impact in public and business spaces alike. Large-scale investment is flowing into establishing big data capabilities in many organizations, despite the limited number of cases in which it has been successfully used in completed projects and initiatives. Decision makers already acknowledge the future influence of data-driven decision-making.

However, organizations confront vast differences in their ability to utilize big data to good effect, as seen in their stages of big data maturity. These differences range from adopting big data practices for operational improvement in selected functional areas or building or revamping an organization's value proposition to completely transforming their business model based on big data. At the more advanced stages, organizations learn to monetize big data far beyond simply getting better at what they are currently doing; learning this lesson is an accomplishment that can mean a fundamental shift for them. Environment readiness plays a pivotal role in enabling such success, because its effect is far greater than the evolution of individual organizations' internal capabilities and usage levels of big data.

Nonetheless, policymakers and organizations in general still have much to do if they want to realize the full potential of big data. For their part, governments throughout the world need to create a supportive environment for the usage of big data to attract business to their region. Meanwhile, organizations must act in a timely manner to determine how they can most effectively deploy big data. They will have to predict what the world of data-driven insights will look like in the medium term, anticipate which trends will lead there, and position their organization accordingly.

Within the next five years, big data will become the norm, enabling a new horizon of personalization for both products and services. Wise leaders will soon embrace the game-changing opportunities that big data affords for their societies and organizations, and will provide the necessary sponsorship to realize this potential. Skeptics and laggards, meanwhile, look set to pay a heavy price.

NOTES

1 IBM, no date. "What Is Big Data?"

2 Constine 2012.

3 Aberdeen Group 2013.

4 McAfee and Brynjolfsson 2012, p. 6.

5 Gartner 2013.

6 The New York Times 2012.

7 ITP.net 2013.

8 The Economist Intelligence Unit 2013.

9 This chapter contains examples from many clients whose identities are not stated due to confidentiality reasons.

10 Munford 2013.

11 Catts 2012.

12 In the UK, the initiative is available at http://data.gov.uk/; in New York City it is available at https://data.cityofnewyork.us/.

13 Polonetsky and Tene 2013.

14 OECD 2013.

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CHAPTER 1.4

Big Data: Balancing the Risks and Rewards of Data-Driven Public Policy

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In June 2013, massive US surveillance of phone records and Internet data was revealed by former National Security Agency (NSA) contractor Edward Snowden, who called these activities the "architecture of oppression." His disclosures ignited an overdue public debate on the balance between personal privacy and our growing digital capabilities regarding the collection and use of personal data. Finding this balance is an issue of vital and urgent interest to corporations and governments as well as to ordinary citizens around the world. This chapter will outline both the risks and the rewards of this new age of big data, address policy issues in this area, and provide practical recommendations for a way forward.

Data about human behavior, such as census data, have always been essential for both government and industry to function. In recent years, however, a new methodology for collecting data about human behavior has emerged. By analyzing patterns within the "digital breadcrumbs" that we all leave behind us as we move through the world (call records, credit card transactions, and global positioning system, or GPS, location fixes, for example), scientists are discovering that we can begin to explain many things—such as financial crashes, revolutions, panics—that previously appeared to be random events. These new tools, with the perspective they provide on life in all its complexity, shape the future of social science and public policy. Just as the microscope and telescope revolutionized the study of biology and astronomy, "socioscopes" have the potential to revolutionize regulation and public policy.

The risk of deploying this sort of data-driven policy and regulation comes from the danger of putting so much personal data into the hands of either companies or governments. Fortunately, new approaches to regulation and technology that can help protect personal privacy from exploitation have been developed. These approaches can mitigate the problem of government overreach as well. Both regulation and technology must continue to evolve in order to provide more scientific, real-time public policy while protecting citizens from the dangers of exploitative companies or an all-knowing authoritarian government. This chapter will provide practical recommendations to achieve these goals.

A BIG DATA TAXONOMY

It is probably hopeless to try to provide a detailed taxonomy of data types and uses because the technology is progressing so quickly. But it is possible to provide a broad taxonomy framed in terms of control. The three main divisions within the spectrum of data control are: (1) *data commons,* which are available to all, with at most minor limitations on use; (2) *personal or proprietary data,* which are typically controlled by individuals or companies, and for which legal and technology infrastructure must provide strict control and auditing of use; and (3) the *secret data of governments,*

which typically has less direct public oversight and more stringent controls. The issues of data commons will be addressed first, followed by concerns about personal and proprietary data, and, finally, issues of secret government data.

The preferred lens for examining these issues is experimentation in the real world rather than arguments from theory or first principles, because using massive, live data to design institutions and policies is outside of our traditional way of managing things. In this new digital era we cannot rely only on existing policy, tradition, or even laboratory science, because the strengths and weaknesses of big data analysis are very different from those obtained through standard information sources. To begin to manage our society in a data-driven manner requires us to move beyond academic debate and laboratory question-and-answer processes. Instead, we need to try out new policy ideas within living laboratories—real, diverse communities that are willing to try a new way of doing things—in order to test and prove our ideas. This is new territory and so it is important for us to constantly try out new ideas in the real world in order to see what works and what does not (see Box 1).

Data commons

The first entry in the data taxonomy is the *data commons.* A key insight is that our data are worth more when shared because they can inform improvements in systems such as public health, transportation, and government. Using a "digital data commons" can potentially give us unprecedented ability to measure how our policies are performing so we can know when to act quickly and effectively to address a situation.

We already have many data commons available: maps, census data, and financial indices, for example. With the advent of big data, we can potentially develop many more types of data commons; these commons can be both accessible in real time and far more detailed than previous, hand-built data commons (e.g., census data, etc.). This is because the new digital commons depend mostly on data that are already produced as a side effect of ongoing daily life (e.g., digital transaction records, cell phone location fixes, road toll records, etc.), and because they can be produced automatically by computers without human intervention.

One major concern with these new data commons is that they can endanger personal privacy. Another, secondary, concern involves the tension between proprietary interests, both commercial and personal, and the goal of putting data in the commons. Acceding to these proprietary interests might tend to reduce the richness of such a commons, which would diminish the ability of such a data commons to enable significant public goods.

To explore the viability of a big data commons, what is perhaps the world's first true big data commons was unveiled on May 1, 2013. In this Data for Development (D4D) initiative, 90 research organizations from around the world reported hundreds of results from their analysis of data describing the mobility and call patterns of the citizens of the entire African country Côte d'Ivoire.[1] The data were donated by the mobile carrier Orange, with help from the University of Louvain (Belgium) and the MIT Human Dynamics Laboratory (United States), along with collaboration from Bouake University (Côte d'Ivoire), the United Nation's Global Pulse, the World Economic Forum, and the GSMA (the mobile carriers' international trade association). The D4D program was led by Nicolas De Cordes (Orange), Vincent Blondel (Louvain), Alex Pentland (MIT), Robert Kirkpatrick (UN Global Pulse), and Bill Hoffman (World Economic Forum).

The research projects conducted by the 90 participating organizations explored the use of this data commons, covering many different aspects of better governance. An example of using the D4D data to improve social equality was highlighted by work done by researchers at the University College of London, who developed a method for mapping poverty from the diversity of cell phone usage. As people have more disposable income, they explore or sample their environment more, and their patterns of movement and patterns of phone calls become increasingly diverse. Measurement of this additional exploration allows us to make a surprisingly accurate estimate of their disposable income. Another example of using the D4D data to enhance social equality is the mapping of ethnic boundaries by researchers from the University of California, San Diego. This method relies on the fact that ethnic and language groups communicate far more within their own group than they communicate with other groups. This project is significant because, while we know that ethic violence often erupts along such boundaries, the government and aid agencies are usually uncertain about the geography of these social fault zones.

The D4D data were also utilized to understand and promote operational efficiency through an analysis of Côte d'Ivoire's public transportation system by IBM's Dublin laboratory. This analysis showed that, for very little cost, the average commute time in Abidjan—Côte d'Ivoire's biggest city—could be cut by 10 percent. Other research groups demonstrated similar potential for operational improvements in the areas of government, commerce, agriculture, and finance.

Finally, examples of using D4D data to improve social resiliency include analysis of disease spread by groups from Novi Sad University (Serbia), École Polytechnique Fédérale de Lausanne (EPFL, Switzerland), and Birmingham (United Kingdom). These research groups showed that small changes in the public health system could potentially cut the spread of flu by 20 percent as well as significantly reduce the spread of HIV and malaria.

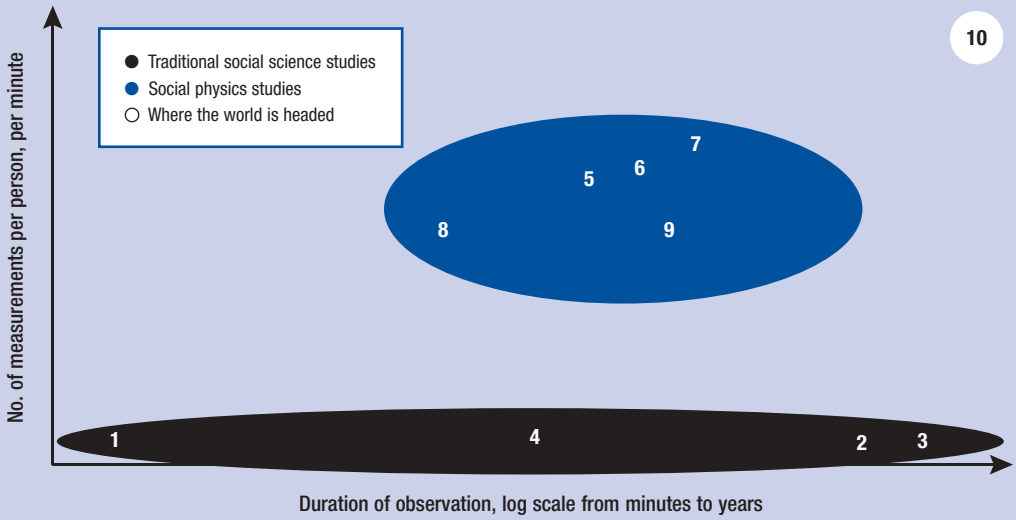
Box 1: The future of big data and governance

The Data for Development (D4D) data commons is only a small first step toward improving governance by using big data. Much more can be accomplished because our current understanding of policy and human society is based on very limited data resources. Currently, most social science is based either on analysis of laboratory experiments or on survey data. These approaches miss the critical fact that it is the details of which people you interact with, and how you interact with them, that truly matter. Social phenomena are made up of billions of small transactions between individuals—people trading not only goods and money but also information, ideas, or just gossip. There are patterns in those individual transactions that drive phenomena such as financial crashes and Arab Springs. We need to understand these micro-patterns because they do not just average out to the classical way of understanding society. Big data gives us—for the first time—a chance to view society in all its complexity, composed of millions of networks of person-to-person exchanges.

Figure A compares social science living labs with traditional experiments. The horizontal axis presents the duration of the data collection; the vertical axis shows the richness of the information collected.

If we had an all-seeing view, we could potentially arrive at a true understanding of how society works and develop scientifically proven methods to fix our problems. Unfortunately, as illustrated in Figure A, almost all data from traditional social science (labeled "1" in the figure) are near the (0,0) coordinate, meaning that these datasets represent information gathered from under a hundred people and for only for a few hours. The studies labeled "2" and "3" are some of the largest social science studies to date.[1] In the last decade, computational social scientists have begun to discover how to leverage big data and have been using datasets from companies such as cell phone carriers and social media firms. Typical examples of these studies are labeled "4."

Figure A: Qualitative overview of social science living labs and traditional experiments



Note: Datasets identified in the figure are derived from the following: 1 = most social science experiments, 2 = the Midwest Field Station Study, 3 = the Framingham heart study, 4 = large call record datasets, 5 = reality mining, 6 = social evolution, 7 = friends and family, 8 = sociometric badge studies, 9 = the D4D dataset, and 10 = where the world is headed (see text for explanation).

Unfortunately, even these large datasets are impoverished because they measure only a few variables at a time, thus providing only a very limited view of human nature. Recently data scientists have developed living lab technologies for harvesting digital breadcrumbs, and are now obtaining much richer descriptions of human behavior. The studies labeled "5," "6," "7," and "8" are living lab studies that use smart phones or electronic name badges (sociometers) to collect data.[2] The point labeled "9" is the D4D dataset that covers the entire country of Côte d'Ivoire.[3]

Just a brief examination of Figure A makes it easy to see that these living lab datasets are many orders of magnitude richer than previous social science datasets. These large, digital datasets contain extraordinary amounts of objective, continuous, dense data that allow us to build quantitative, predictive models of human behavior in complex, everyday situations.

Importantly, the point labeled "10" shows where the world is headed. In just a few short years we are likely to have available incredibly rich data about the behavior of virtually all of humanity on a continuous basis. The data mostly already exist in cell phone networks, credit card databases, and elsewhere, but currently only technical gurus have access to them. As these digital data become more widely available for scientific inquiry, we will be able to understand and manage ourselves in ways better suited to our complex, interconnected, and networked society.

Notes

1 See Barker 1968; Dawber 1980.

2 For details about these living lab studies, see Pentland 2014; Mobile Territorial Lab (MTL), available at http://www.mobileterritoriallab.eu/.

3 See the D4D challenge, available at http://www.d4d.orange.com/home.

These selected results are just a small sample of the impressive work that is made possible by this rich and unique data commons. These results and others like them are available at http://www.d4d.orange.com/home. Each of these D4D research projects has demonstrated the great potential of a big data commons for improving people's living conditions. From the point of view of Orange, it also demonstrates the potential for new lines of business that combine this data commons with customers' personal data: imagine phone applications that advise commuters about which bus will get them to work quickest, or that help citizens reduce their risk of catching the flu.

The work of these 90 research groups also suggests that many of the privacy fears associated with the release of data about human behavior may be generally misunderstood. In this data commons, the data were processed by advanced computer algorithms (e.g., sophisticated sampling and the use of aggregated indicators) so that it was unlikely that any individual could be re-identified. In fact, no path to re-identification was discovered even though several of the research groups studied this specific question.

In addition, although the data were freely available for any legitimate research in which a group was interested, the data were distributed under a legal contract that specified that they could be used only for the purpose proposed and only by the specific people making the proposal. A similar technology-legal framework is used in trust networks described in the next section. The use of both advanced computer algorithms and contract law to specify and audit how personal data may be used and shared is the goal of new privacy regulations in the European Union, the United States, and elsewhere.

Personal and proprietary data

The second category in the data taxonomy is *personal and proprietary data,* which are typically controlled by individuals or companies, and for which legal and technology infrastructure that provides strict control and auditing of use is needed. The current best practice is a system of data sharing called *trust networks.*[2] Trust networks are a combination of a computer network that keeps track of user permissions for each piece of personal data and a legal contract that specifies both what can and cannot be done with the data and what happens if there is a violation of the permissions. This is the model of personal data management that is most frequently proposed within the World Economic Forum Personal Data Initiative.

In such a system, all personal data have attached labels specifying what the data can, and cannot, be used for. These labels are exactly matched by terms in a legal contract between all the participants stating penalties for not obeying the permission labels and giving the right to audit the use of the data. Having permissions, including the provenance of the data, allows automatic auditing of data use and allows individuals to change their permissions and withdraw their individual data.

Today, long-standing versions of trust networks have proven to be both secure and robust. The best known example is the SWIFT network for inter-bank money transfer; its most distinguishing feature is that it has never been hacked. When asked why he robbed banks, bank robber Willie Sutton famously said, "Because that's where the money is." In today's world, the SWIFT network is where the money is—trillions of dollars are moved through the network each day. This trust network has not only kept the robbers away, but it also makes sure the money reliably goes where it is supposed to go. Until recently, such systems were available only to the "big guys." To give individuals a similarly safe method of managing personal data, the MIT Human Dynamics Laboratory (http://hd.media.mit.edu), in partnership with the Institute for Data Driven Design (http://idcubed.org), have helped build openPDS (open Personal Data Store)—a consumer version of this type of system. We are now testing it with a variety of industry and government partners.[3]

A major concern about trust networks is the cost associated with keeping track of permissions and supporting the capability for automated auditing. Since many companies already maintain such data structures in order to support internal compliance and auditing functions, the cost concern does not appear to be a major barrier. Another more serious concern, however, is the extent to which incidental data about human behavior must be included in the permissions and auditing framework. Such data are typically collected in the course of normal operations in order to support those operations (e.g., the location of a cell phone is required to complete phone calls), but without specific informed consent. A final concern is that a trust network system may be too complex for average people to use, or that it will not inspire (or deserve) the sort of user trust that the name suggests.

In order to investigate these concerns, a living lab has been launched with the city of Trento in Italy, supported by Telecom Italia, Telefonica, the MIT Human Dynamics Laboratory, the Fondazione Bruno Kessler, the Institute for Data Driven Design, and local companies within Trento. Importantly, this living lab has the approval and informed consent of all its participants—they know that they are part of a real-world experiment whose goal is to invent a better way of living.[4]

The objective of this living lab is to develop new ways of sharing data to promote greater civic engagement and information diffusion. One specific goal is to build upon and test trust-network software such as the openPDS system by deploying a set of "personal data services" designed to enable users to collect, store, manage, disclose, share, and use data about

themselves. For example, the openPDS system lets the community of young families learn from each other without the work of entering data by hand or the risks associated with sharing through current social media. These data can then be used for the personal self-empowerment of each member, or (when aggregated) for the creation of a data commons that supports improvement of the community—for example, a map that shows disposable income for each neighborhood can stimulate better distribution of community services. The ability to share data safely should enable better idea flow among individuals, companies, and government; we want to see if these tools can in fact increase productivity and creative output at the scale of an entire city.

The Trento living lab will also investigate how to deal with the sensitivities of collecting and using deeply personal data in real-world situations. For example, it will explore different techniques and methodologies to protect the users' privacy while at the same time being able to use personal data—typically mobility, financial, and medical records—to generate a useful data commons. It will also explore different user interfaces for privacy settings, for configuring the data collected, for the data disclosed to applications, and for those data shared with other users, all in the context of a trust framework. Although the Trento experiment is still in its early days, the initial reaction from participating families is that these sorts of data-sharing capabilities are valuable, and they feel safe sharing their data using the openPDS system.

Government data

The third category in the taxonomy is *secret government data.* A major risk of deploying data-driven policies and regulations comes from the danger of putting so much personal data into the hands of governments. But how can it happen that governments, especially authoritarian governments, choose to limit their reach? The answer is that unlimited access to data about the citizen behavior is a great danger to the government as well as to its citizenry. Consider the NSA's response to the recent Snowden leaks:

> "This failure originated from two practices that we need to reverse," Ashton B. Carter, the deputy secretary of defense, said recently. "There was an enormous amount of information concentrated in one place," he said. "That's a mistake." And second, no individual should be given the kind of access Mr. Snowden had, Mr. Carter said.[5]

That is, the government must organize big data resources in a distributed manner, with each different type of data separated and dispersed among many locations, using many different types of computer systems and encryption. Similarly, human resources should be organized into cells of access and permission that are localized both spatially and by data type. Both computer and human resources should always be redundant and fragmented in order to avoid overly powerful central actors.

The logic behind this observation is that databases that have different types of data that are physically and logically distributed, and that also have heterogeneous computer and encryption systems, are hard to attack, both physically as well as through cyberattack. This is because any single exploit is likely to gain access to only a limited part of the whole database. Similarly, the resilience of organizations with a heterogeneous cell-like human and permissions structure is familiar from intelligence and terrorist organizations. Importantly, resistance to attack by adopting a distributed organization is a particularly pressing issue for authoritarian governments, because unfettered access to data about citizen behavior can be a major aid to organizing a successful coup to overthrow the government.

What does all this have to do with the danger that a big data government will trample individual freedoms? The key insight is that for these types of data systems, each type of data analysis operation has a characteristic pattern of communication between different databases and human operators. As a consequence, it is possible to monitor the functioning of the data analysis process without gaining access to, or endangering, the analysis content. In short, one can use "metadata about metadata" in order to monitor the *use* of metadata, and with some reasonable confidence one can ensure that only normal and usual analysis operations are being conducted without reference to specific content. Governments that structure their data resources in this manner can more easily monitor attacks and misuse of all sorts.

As a concrete example, let us assume a system in which different types of databases are physically distributed. In this case one can observe the amount and pattern of traffic between the different databases. These patterns are characteristic of the analysis being performed, and so deviations from the normal patterns of communication between databases are cause for concern. In this manner, an open civil authority can perform substantial, fairly effective monitoring of the functioning of a classified agency. In most cases it is sufficient that each element of the system monitor only local traffic.

A familiar example of this type of monitoring is the "many eyes" security strategy. When patterns of communication among different departments are visible (as with physical mail), then the patterns of normal operations are also visible to many employees, even though the content of the operations (the content of

the requested records) remains hidden. For example, a health official responsible for maintaining health records will be able to see if those records are suddenly being accessed by the finance records office with unusual frequency, and may inquire if that is proper. In contrast, when copies of all the data types are all in one place (as when all the records are located in one filing cabinet), it is easy for people to conduct unauthorized analyses.

The computer architecture for the type of system that relies on multiple, distributed types of oversight is very similar to that of the trust networks described in the previous section: distributed data stores with permissions, provenance, and auditing for sharing among data stores. In this case, however, the data stores are segmented by their referent—for example, tax records for individuals, tax records for companies, import records from country X to port Y, and so on—rather than having one data store per person. Because the architecture is so similar to the citizen-centric personal data stores, it enables easier and safer sharing of data between citizens and government. For this reason, several states within the United States are beginning to test this architecture for both internal and external data analysis services.

Finally, it should not escape the reader's attention that all of these lessons also apply to companies with large, complex databases. Misbehavior by employees, industrial espionage, and cyberattack are among the greatest dangers that companies face in the big data era. A distributed architecture of databases joined with a network that supports permissions, provenance, and auditing can reduce risk and increase resilience of companies' internal data analysis functions.

SUMMARY

We are entering a big data world, where governance is far more driven by data than it has been in the past. Basic to the success of a data-driven society is the protection of personal privacy and freedom. Discussions at the World Economic Forum have made substantial contributions to altering the privacy and data ownership standards around the world in order to give individuals unprecedented control over data that are about them, while at the same time providing for increased transparency and engagement in both the public and private spheres.

We still face the challenge that large organizations, in particular governments and corporations, may be tempted to abuse the power of the data that they hold. To address this concern, we need to establish best practices that are in the interest of both large organizations and individuals. This chapter has suggested one path that can limit potential abuses of power while at the same time providing greater security for organizations that use big data. The key policy recommendations for all large organizations, commercial or government, are that:

1. Large data systems should store data in a distributed manner, separated by type (e.g., financial vs. health) and real-world categories (e.g., individual vs. corporate). These systems should be managed by a department whose function is focused on those data, with sharing permissions set and monitored by personnel from that department. Best practice would have the custodians of data be regional and use heterogeneous computer systems. With such safeguards in place, it is difficult to attack many different types of data at once, and it is more difficult to combine data types without authentic authorization.

2. Data sharing should always maintain provenance and permissions associated with data, and should support automatic, tamper-proof auditing. Best practice would share answers only to questions about the data (e.g., by using the pre-programmed structured query language, or SQL, queries known as "Database Views") rather than sharing the data themselves, whenever possible. This allows improved internal compliance and auditing and helps to minimize the risk of unauthorized information leakage by providing the minimum amount of information required.

3. Systems controlled by partner organizations, and not just one's own systems, should be secure. External data sharing should take place only between data systems that have similar local control, permissions, provenance, and auditing, and should include the use of standardized legal agreements such as those employed in trust networks, as described earlier. Without such safeguards, data can be siphoned off at either the data source or at the end consumer, without even attacking central system directly.

4. The need for a secure data ecosystem extends to the private data of individuals and the proprietary data of partner companies. As a consequence, best practice for data flows to and from individual citizens and businesses is to require them to have secure personal data stores and be enrolled in a trust network data sharing agreement.[6]

5. All entities should employ secure identity credentials at all times. Best practice is to base these credentials on biometric signatures.[7]

6. Create an "open" data commons that is available to partners under a lightweight legal agreement, such as the trust network agreements. Open data can generate great value by allowing third parties to improve services.

Although these recommendations might seem cumbersome at first glance, they are for the most part easily implemented with the standard protocols already

found within modern computer databases and networks. In many cases, the use of distributed data stores and management are *already* part of current practice, and so the entire system will be simpler and cheaper to implement than a centralized solution: all that is really new is the careful use of provenance, permissions, and auditing within a legal or regulatory framework such as a trust network. Most importantly, these recommendations will result in a data ecosystem that is more secure and resilient, allowing us to safely reap the advantages of using big data to help set and monitor public policy.

NOTES

1 See the D4D challenge, available at http://www.d4d.orange.com/home.

2 For examples of trust networks, see Pentland 2009; World Economic Forum 2011; and the Institute for Data Driven Design, available at http://idcubed.org.

3 For details about openPDS, see http://idcubed.org/open-platform/openpds-project/.

4 For information about the Mobile Territorial Lab (MTL), see http://www.mobileterritoriallab.eu/.

5 Sanger 2013.

6 Pentland 2009; World Economic Forum 2011; http://idcubed.org.

7 See http://openid.net/connect/.

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CHAPTER 1.5

Managing the Risks and Rewards of Big Data

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One of the biggest challenges of the term *big data* is deciding on a standard definition of what those words really mean. For many companies that have worked in an environment of large datasets, fast-moving information, and data that lack traditional structure, working in an environment of big data is just business as usual. In this chapter we will discuss how managing the growing challenge of data is not new for a regional healthcare organization in the Midwestern United States, a global logistics company, and a major American retailer. But for a majority of organizations, which have neither integrated data nor built a strategy around its use, the term *big data* itself is a way to express the sudden digitization of many things that have been with us forever but were not previously captured and stored as data. For most companies, big data represents a significant challenge to growth and competitive positioning. In some cases, it represents the survival of the business.

BIG DATA: RISKS AND REWARDS

Digitization itself is not new, but the maturation and availability of the Internet; the rapid growth of mobile computing; and, more recently, the addition of sensor data (data derived from devices that sense their environment) to the mix have all pushed the boundaries of how we think about data and its uses. The term *big data* represents the need for a new way of thinking but also implies new tools and new ways of managing data. Like many things, data can be used to do positive things for the world, but it can also be used to manipulate, embarrass, or repress. Data can be highly accurate and efficiently structured or unstructured, fragmented, and highly suspect. Data can also be managed well or carelessly. Big data, in its outsized properties, amplifies those effects. It is in those extremes that the risks and rewards of big data are decided.

THREE KEY BIG DATA TRENDS

As the world becomes more familiar with big data, three key trends that have a significant impact on those risks and rewards are emerging. First and foremost, *big data leverages previously untapped data sources.* Those sources are of several types. The first includes wearable devices that stream data about an individual and his or her surrounding environment on a moment-by-moment basis—such sensors include the applications on a smartphone that sense movement. The sensor in a runner's shoe is a very consumer-facing example, but business-facing sensors, which track all kinds of things, are proliferating very quickly. A pacemaker is a sensor that has been around a while (the newer models give feedback to healthcare workers).

The next type comprises connected sensors that instantly digitize and report what is happening in any moment and in any location. Examples of this type include the global positioning system (GPS) device that reports location back to a central computer or a user,

and devices in the soil of a farm that sense when and how much to irrigate. There are also sensors in trains, for example, that watch for signals that maintenance is necessary before a human could ever see them, such as brake heat, brake wear, movement in the rails, and so on. This new breed of sensors is coming into service and is connected to the Internet, making big data even bigger than human-generated information.

The third type of sensor provides constant reporting by machines that perform the work critical to our security, health, and lifestyle. Machines can be something as large as an aircraft or locomotive or they can be components of one of those things. Some of the most interesting of these sensors are the ones that measure the way an aircraft engine is performing mid-flight. Machines used to be purely mechanical but are increasingly computer controlled. Those computer controls mean not only that data are constantly being fed into machines but that they are also coming out of machines at a quickly increasing rate.

We have reached a point of information discovery that reveals correlation before causation, leaving researchers scratching their heads to find the underlying causes for correlations that data analysis clearly demonstrates. TIBCO's chief executive officer, Vivek Ranadive, is fond of saying that we have reached a point where we may know the "what" without knowing the "why."

The previously untapped information sources create a data ecosystem that can be modeled in a way that blends historical with in-the-moment information and is remarkably useful for anticipating the future. These models accurately predict such diverse outcomes as the spread of disease, the failure rate of aircraft components, and consumer behaviors. Big data's effectiveness is tightly coupled to an organization's ability to bring the right data together in the right moments that allow for the right response and outcome. Whatever we may know today, the continued discovery of previously untapped data sources will continue to change and improve our models, allowing us to better anticipate future events and to continue to increase our ability to affect desired outcomes.

The desire to affect outcomes brings about the second trend of big data: *the need for automation technologies.* Richard Hackathorn wrote about the value-time curve of information back in 2004 in "Real-Time to Real-Value," just as the world was becoming broadly and acutely aware of the explosion of data.[1] Hackathorn's curve describes the decreasing value of data over time as it passes through stages of use (Figure 1).

The challenge of the decreasing value of data over time has become even more meaningful in the age of big data. Today, the volume, velocity, and variety of data continue to push the curve down and to the right as organizations struggle to capture, analyze, and decide in a gradually more difficult environment. Added to this complexity is the increasing access to real-time data that leaves organizations in some industries attempting to reduce their response time to microseconds, understanding that this is a crucial part of being successful in their business.

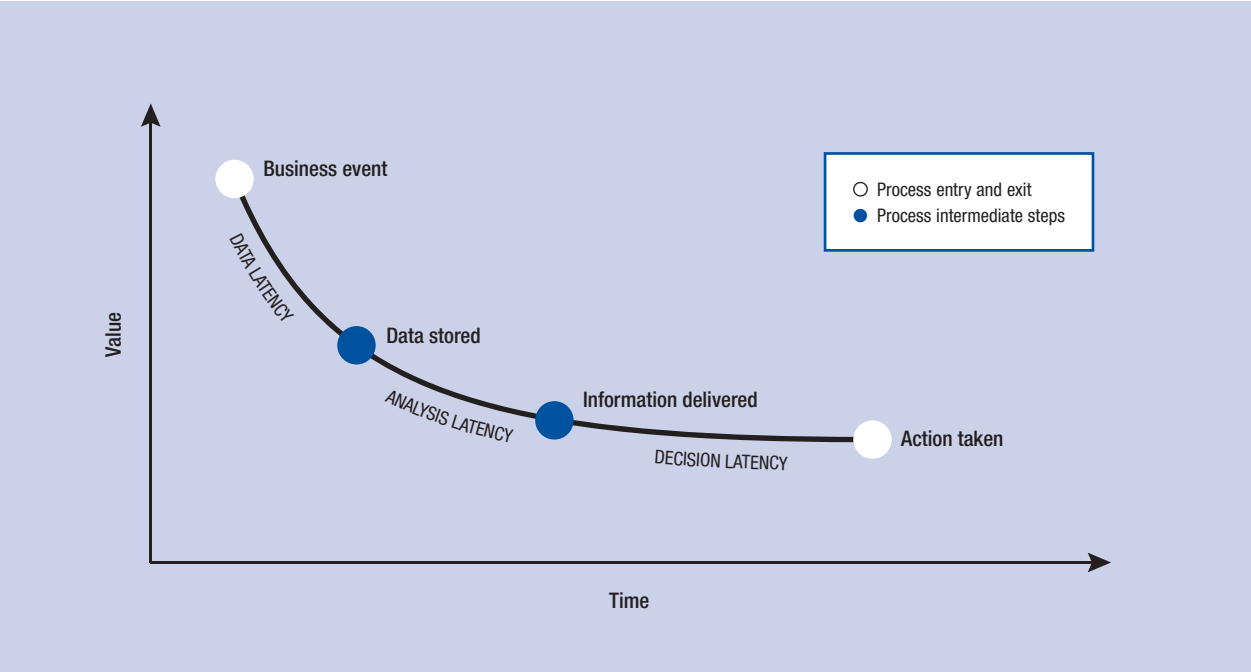
The value-time curve challenge makes big data management a function of creating automation wherever possible. Machines have always been humanity's friend in making work more efficient, and big data follows the same path. Big data's growth in each of its dimensions eliminates the ability for humans to intervene and reprogram processes in real time, opening the door for better and better tools that can manage data far more quickly and efficiently than a human can. Data exist in a moment, ready for decision and action, but there is a higher-level purpose for information. Data comprise the digital representation of events, or things that happen in patterns that occur over time, in conjunction with other events or in isolation, and even with things that may be expected but do not occur (such as when a patient fails to pick up a prescription after being discharged from a hospital, starting a likely string of events that will lead to readmission).

The idea of keeping track of what does *not* occur is a level of complexity higher than the old ways of waiting for data to arrive or change. Automation is especially well suited to the complexity of predicting, and then anticipating, events. In many organizations, automation is also a significant part of the actions that events precipitate.

The big data conversation often centers on the use of machines as the best resource for the storage and analytic processing of vast amounts of data, but this is only a piece of the story. Automation is increasingly a logical response to the need to find, filter, and correlate each piece of data as it flows over the enterprise so that decisions can be made—some through automation and some using a hybrid approach combining human and machine. Once decisions are reached, automation becomes the path for taking action in the shortest time frame possible before the value of data decays further.

The third trend being driven by big data is the *necessity for adaptable, less fragile systems.* For big data to leverage previously untapped sources of information, organizations need to quickly adapt to the opportunities and risks represented by these new sources. Automated systems that manage big data ecosystems cannot be developed around rigid schemas that require redevelopment for each new stream of information. Instead, systems need to absorb new information in an adaptable way that also adds value to existing data that have already been collected. Adaptable systems treat new sources of data coming constantly as the means to improve analytical models, create better decisions, and drive more appropriate actions.

Figure 1: The value-time curve



Source: Hackathorn 2004.

RESOLVING TWO PRIMARY CHALLENGES OF BIG DATA

Most organizations need to overcome two primary challenges before becoming productive with big data. The first is the need for powerful visualization that allows the business to explore data to find questions worth answering. This stands the traditional business intelligence model on its head, as the pre–big data model began with the business asking a question and ended with information technology structuring data to answer those questions in a very repeatable way, typically as dashboards. Visualization instead begins with capturing all data available so that multi-structured and iterative discovery can take place that reveals information with or without having the right question. Visualization lets the data speak for themselves.

Humans are extremely well suited to visual analysis. Our brains are wired to very rapidly assimilate what we see and spot patterns. Using our eyes, we can spot a trend or an outlier in a fraction of a second, far faster than we can by sifting through numbers on a screen. If a picture is worth a thousand words, visualization is worth petabytes, terabytes, and more of raw data. Visualized data and the human mind make for a highly efficient combination. Most importantly, visualized data have the effect of engaging the non-technical but business-savvy human in the iterative process of discovering exploitable insight. This lessens the organization's reliance on technical resources and, specifically, on data scientists.

The second hurdle that organizations face is the need to manage ever-larger amounts of data. Systems scoped for today's needs quickly become insufficient when the data are increasing in size, speed, and complexity. Unfortunately, when people talk about "big data" they often use the term to compartmentalize it and give it boundaries. This is a natural reaction and harkens to the beginning of computerization when data were processed as batches of transactions that represented a finite amount of information. Thinking of big data in those terms fails to take into account all of the data being created everywhere, every day. This compartmentalized view can also deprecate data that may not appear useful or valuable or may be difficult to process. At a point in the future, organizations will very likely look back and wish they had considered all data when deciding what to store. When we consider data without specific boundaries, we can focus our efforts on linking data together and analyzing them more broadly. We will probably find the data have value for a wider range of people in the organization than originally anticipated.

When we consider all data, we can see the value of discovering the connectivity of data. This brings into consideration different data types that are used to adorn our original data and make them more valuable as a source of visual, predictive, and operational analytics. Why does that matter? We have grown accustomed to having instantaneous answers to our questions. As data grow, they have the very real likelihood of slowing down how decisions are made. Nonlinear growth taxes our systems and creates the scenario that every day we get bogged down more as untapped data sources become newly available, our clever automations become less effective, and our systems seem less adaptable than before. An all-data approach allows the organization to see today's information as the best we have in the moment, knowing that we will continue to layer on more

data—not with the goal of having a larger dataset, but instead with the goal of using all of the data available to gain the best outcome. Rather than slowing down the results, using all available data takes into account data linkages and permits a broad analysis that allows the most organizational clients to constantly arrive at the best possible outcome.

Enabling the organization with visualization and the constantly additive benefits of all data allows experts to be able to explore data to find their value. For a retailer, that means being able to explore diverse data that include historical visits to the website as well as transactions completed or shopping carts abandoned; with the addition of geographical information from a mobile society, the retailer has an ability to understand the ambient circumstances at the time decisions are being made.

ENSURING THAT HUMANS STAY IN THE LOOP

For exactly this reason we need to take a very careful approach to how big data is being used and apply the right level of oversight. There are two specific reasons for having an appropriate governance model, each tackling the problem from the opposite perspective. The first is a need to ensure that data are not being used in a way that goes against the organization's best interests. Such unfortunate (even inappropriate) uses can be the result of rogue individuals with no checks and balances on their access and actions, or it can be the result of individuals acting with the best intentions but incurring unintended consequences that go against the goals of the organization. Data are very powerful, and organizations need to ensure that information is being collected, stored, analyzed, and acted upon in ways that can be audited and that raises alarms when necessary.

The second need for governance is demonstrated by the danger of having machines talking to machines without a human supervising the conversation. Systems need to leave an aperture for control by humans to avoid the problems of passive neglect or runaway processing. Finding the right balance is the challenge, and it involves looking at the value of the decisions being reached and the risk associated with the decision. There is a broad spectrum of judgments that covers small, incremental decisions that have moderate impact on an overall risk profile versus large, occasional decisions that can have enormous impact. Machines are exceptionally good at monitoring and executing detail, but the need for humans to focus on the macro decisions is significant. Consider the car analogy: a human cannot be involved in every firing of every cylinder. The human has absolute responsibility, however, for the speed of the car under the current conditions, monitoring the engine temperature, and a host of other variables.

STRIKING A PRIVACY BALANCE

We have watched the sharing of personal data increase year after year since people first connected across the Internet. Many of the risks and rewards of big data are coupled tightly to the use of all of those data. On the reward side, data can be used to create far better customer service by knowing the customers' needs and histories. They can be used to create more personalized offers based on customers' preferences and their loyalty to a brand. From this perspective, data can be used to engage the customer and to create a better relationship that serves everyone's needs. Healthcare-related personal information improves treatment and saves lives both at the individual level and in aggregate, as clinical trials of sample patients give way to all data about every patient.

Personalization and healthcare offer two standout opportunities for big data to reward us. At the same time, big data comes with privacy concerns that are not simply related to technology but are also about very human things such as privacy, all-knowing "creepiness," and personal security. Given enough personal data, information can be correlated that can be both unsettling and unwanted. Today's public, legislative, and legal sentiments may not be tomorrow's, and these attitudes tend to diverge by government and region of the world. What is standard practice in terms of collecting personal information in the United States is frowned upon in many parts of Europe. Managing the "Facebook Effect," where people willingly share ever-increasing amounts of personal information, is a challenge for individuals and governments as well as for the software companies that sit in the middle, confronted with inconsistent norms and laws across different locations in the world.

Privacy paradigms are in constant flux, but the need for a consistent approach to meet privacy expectations never changes. Protecting privacy has, at its roots, the need to protect data both at a discrete level and, maybe even more importantly, at an aggregate level. Learning a great deal about a person by combining factors that may seem harmless at a discrete level but, when taken together, may give away information that the person would not want generally known is one such example. This could happen, for instance, by combining someone's Facebook status with the location where he or she logged in to pay an electric bill with the home zip code; this could target wealthy people by knowing that they are not at home, making them vulnerable to burglaries. Each discrete piece of information is not meaningful, but in the aggregate can make someone a potential victim.

Systems exist that can manage the access, movement, and dissemination of data, but in our haste to build out the largest datasets and the maximum computational power, the need to put the right controls in place has been consistently overlooked. Some of this has been naiveté, and some has been a deliberate

stretching of the boundaries of individual expectations. Throughout the evolution of big data, the capability to govern data appropriately has existed, but unless organizations make the choice themselves or are pushed by legal or public pressure, the protection of personal privacy remains a low priority.

SHOWING BIG DATA'S SOPHISTICATED SYSTEMS

Gaining benefits from big data while mitigating risks is entirely a matter of data systems sophistication. This section will explore three examples that demonstrate the successful use of big data.

The first example of that sophistication is on display at a major network of hospitals in the Midwest to address the problem of sepsis—the systemic infection of the body—which is a constant threat to hospitalized patients. Sepsis is usually acquired in the healthcare facility; it is not the reason a patient arrives. Instead, sepsis appears somewhere between a patient's travel between the emergency room, the laboratory, the radiology department, and any other department where treatment is given. If not treated immediately, sepsis usually results in the death of the patient.

This healthcare company realized that, in order to tackle the sepsis problem, they had to create a sophisticated system that could follow a patient throughout his or her stay. The system needed to track patient data despite that patient's location within the hospital and despite the siloed information technology systems that are all too common in healthcare. Most of all, the system needed to bring data together in a way that allows high-speed correlation, based on prior analysis of sepsis data, so that medical staff can be alerted within life-saving time frames. This company's sophisticated system was successful at significantly shortening time frames for response to sepsis and significantly decreased the mortality rate in their facilities. They were successful enough, in fact, to allow their system to be turned into a Software-as-a-Service and contracted to other facilities.[2]

The second example is one of logistics. Like healthcare, logistics is an age-old practice undergoing big data transformation. It has become far more complicated in recent years because of the explosion of data that connect the customer's customer and the supplier's supplier. We are able to know significantly more in the form of digital data that not only allow the prediction of outcomes but that also allow us to make operational decisions at any point along the supply chain. For a global package delivery company, knowing their business means being able to access all available data to monitor not just the arrival and departure of aircraft but also the aircraft altimeter and attitude in order to provide additional layers of data that provide better insight on the nuanced status of the flight.[3] In a similar fashion, today's complex contracts encompass the global movement of pharmaceuticals and other sensitive cargos that require constantly monitoring all data. A global logistics company must monitor discrete data such as package temperature, location, and time to delivery that continually describe a shipment's ambient conditions; furthermore, these data must be available alongside expiration data and acceptable data ranges.

Those aggregate data form the basis for ensuring non-stop compliance to local and international standards for moving items that require special handling. Those same data ensure that contract terms are being respected and provide the basis for improving profitability while decreasing waste and inefficiency within a contracted service. It is a gift that keeps on giving, as detailed historical shipment data allow better pricing of potential new contracts, making the logistics carrier more competitive and reducing the risk of negotiating and accepting poor contracts. Without the ability to manage all relevant data, logistics companies and their customers would be unable to effectively move cargoes that bring enormous benefits to all parts of the planet.

The third example is seen in retail markets. In retail, the management of big data supports a brand's ability to predict the best product offering and to establish effective marketing and loyalty programs. It also supports better ways to sell and greatly improves customer service execution.[4] Big data offers an enormous reward to retail because successful selling is ultimately about having an excellent understanding of customers and the circumstances in which they buy. Even more importantly, successful retail is about creating the circumstances that *turn a customer into a fan.* A fan feels a personal connection to the brand and is much more likely to be an advocate. From a revenue perspective, a fan has a much greater total lifetime value.

But creating a fan is not a simple exercise in better customer service. Predictive analytics, heavily dependent on powerful visualization, form the basis for knowing the best moments and the best ways to engage with the customer. Understanding the past is key to predicting the future, and visualization reveals the meaningful patterns in data that tell us what happened under a host of variables in the past. Visual analytics tell the retailer what can be anticipated in today's real-time situations and set the stage for blending information streaming constantly from the website, store, and logistical systems, along with data coming from mobile devices. That information is vitally important to knowing not only how to provide information and offers to help a customer through a purchase, but also how to best serve a customer's needs after products have been purchased. The brand that knows its customers using this approach is leaps and bounds ahead of the one that lacks these capabilities.

Although the rewards are clear, a risk remains in gaining the customer's favor while requiring access to so much personal information. Loyalty programs are the

ideal way to gain that access and avoid the creepiness factor. Focused customer loyalty management elicits the customer's permission through a system of rewards and exclusive offers that provides benefit back to the customer, mitigating the risk of a brand being perceived as stalking the customer or invading their privacy.

ENSURING THE BENEFITS, MITIGATING THE RISKS

Managing the three key trends of leveraging previously untapped data sources, using automation wherever possible, and creating less fragile data systems are crucial parts of ensuring the benefits of big data while mitigating its risks. Accomplishing these three objectives requires successfully meeting big data's two main challenges: the need to visualize by using analytics tools and the need to systematically discover, capture, govern, and secure ever-larger amounts of data.

Big data has a remarkable ability to change the world. Its benefits need to be considered as a function of how well its risks are managed. Truly expert handling of big data brings the reward of being able to react to world-changing events, both big and small, at an unprecedented rate and scope. Epidemics can be tracked and miracle drugs developed, but at the same time, there is a need to ensure that humans are not cut out of the loop. Organizations need to carefully plan for the right level of oversight that gives an aperture of control to humans—after all, big data should be working for the benefit of humans, not the other way around.

Organizations that manage big data have an obligation to monitor security device, server, and application logs, all of which generate machine data that provide insight into how, when, and why machines are communicating with other machines. Monitoring the activities of machines allows organizations to watch for patterns and avoid runaway transactions or manipulation that can lead to fraud and other unintended results. Server logs also provide indications of who accessed data and how these data were used, affording critical oversight into potential illegal or unethical access and use of data. Machine data are monitored by healthcare organizations to show compliance with Health Insurance Portability and Accountability Act (HIPAA) standards, banks to prevent credit card fraud, and governments and corporations to watch for and prevent data loss.

Today's public, legislative, and legal sentiments may not be tomorrow's; these attitudes will continue to diverge by government and region. Governments and other organizations need to balance the Facebook Effect, which entails the deliberate sharing of more and more personal information, with the requirements of security and what the marketplace can use for better customer service and marketing. Organizations, both public and private, need to proactively take steps to prevent privacy intrusion whether the public demands such measures or not. European governments provide an example with the "right to be forgotten" for minors across the European Union. Those steps may include obtaining approval, either by asking permission or by gaining permission in exchange for tangible benefits for the collection and use of personal data—a common technique used by customer loyalty programs. Organizations should also consider the use of anonymization techniques to mask personal identities where that is the appropriate path.

Organizations, both public and private, must balance the risks and rewards of big data—especially as big data moves from low impact "experiments" to driving real-time operations and decision-making. Although social acceptance of what data can and will be shared is changing and evolving, its impact on privacy and personal security and the introduction of the creepiness factor are all things to consider. Big data is a fast-moving technology space that will affect all aspects of our lives. Transparency about what, how, and why data will be used will become more important as organizations seek to provide better services and products at both the government and private levels. Taken together, the trends and challenges will shape the path forward for organizations that wish to be deliberate and wise about their use of big data.

NOTES

1 Hackathorne 2004.

2 The website for the service is http://mercytelehealth.com/services/safe-watch/.

3 Confidential client example.

4 Confidential client example.

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CHAPTER 1.6

Rebalancing Socioeconomic Asymmetry in a Data-Driven Economy

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It is more than half a century since economist Fritz Machlup, in his book *The Production and Distribution of Knowledge in the United States,*[1] developed the concept of the *knowledge economy,* a term later popularized by management theorist Peter Drucker.[2] Both used the phrase to differentiate between an economy based largely on goods and services produced by manual labor and an economy based on the production of new ideas, information, and knowledge.

The wide availability of low-cost information and communication technologies (ICTs)—which started in the early 1980s but gained real traction in the mid-1990s with the advent of the public Internet—drove the economic transformation that Machlup and Drucker envisioned. Research by the Organisation for Economic Co-operation and Development (OECD) shows how rapidly the combination of personal computers, digital telecommunication devices, and the Internet impacted economic growth in the early years of that troika. A 2004 OECD paper estimates that inflation-adjusted investment in ICTs accounted for an average of 0.5 percentage points of annual growth in real GDP in OECD countries between 1995 and 2001.[3] This represents about 20 percent of total growth in real GDP—a significant impact. And a 2002 OECD study demonstrated that corporate investment in networked computer systems is consistently associated with increased labor productivity—for example, productivity was found to be 11 percent higher in US manufacturing plants that have computer networks.[4] It took about 80 years for steam engines to increase labor productivity by approximately that amount, about 40 years for electricity, and more than 20 years for pre-Internet ICTs.[5]

Yet it could be argued that what we saw in the years from the early to mid-1990s was less the emergence of a *knowledge* economy than an *information* economy. Early Internet-era ICTs enabled more efficient and effective processing and use of data, resulting in information that was, for the most part, used to improve the performance of *existing* processes, businesses, and industries. Although in some cases that information transformed businesses completely (e.g., Amazon), these are still traditional businesses. To describe what was created during this period as a *knowledge* economy would be an exaggeration. Much information has been generated from the raw data collection made possible by advances in ICTs, and significant new knowledge has been created, but neither is yet the *foundation* on which the global economy is built. That honor still belongs to physical goods and services.

The recent emergence of big data, along with what is being called the "data-driven economy," may finally make possible a *true* knowledge economy—by which we mean entirely new classes of economic activity predicated on insights and value derived from analyzing, contextualizing, and commingling vast datasets in ways that were previously either unknown or impossible. For

companies (and entire economies) to keep growing, the development of such an economy is an imperative: battered by global competition, commoditization, and shrinking product/service cycles, corporations seeking to maintain or grow their profit margins will increasingly rely on creating new (and hard-to-emulate) products and services based on insights derived from the datasets that they own or can gain access to, especially those pertaining to their customers.

Two decades after the emergence of the consumer Internet, the world is awash in data. By one estimate, almost 3 zettabytes (3 billion terabytes) of information had been created by 2012, a digital deluge that is growing at around 50 percent a year.[6] By the end of 2013, the number of wirelessly connected devices, at an estimated 8 billion, will have exceeded the 7.2 billion people on the planet.[7] By 2020, as many as 50 billion devices could be wirelessly connected to the Internet,[8] while the world population is forecast to be fewer than 8 billion people.[9] At the same time, from 2012 to 2017 machine-to-machine data traffic is set to grow an estimated 24 times, to reach 6×10^{17} bytes per month—an astonishing compound annual growth rate of 89 percent.[10] Indeed, the majority of big data will be collected passively and automatically, via machine-to-machine transactions, and users will not be actively involved in the majority of those transactions.

Big data, analytics, and machine learning promise new solutions to previously intractable problems (e.g., in healthcare, disaster response, the environment, and transportation); new businesses will be able to create innovative services by selecting, combining, and parsing data in groundbreaking ways; and individuals will be empowered because they will be able to draw on a wide range of yet-to-be-invented data-based services and tools to improve the quality of their lives. Big data, then, truly does promise to create new knowledge—and indeed new *kinds* of knowledge—on which an entirely new economy can be founded.

However, the knowledge economy relies on the availability of an adequate supply of data to enable the discovery of new knowledge. This requires policy frameworks that permit data—including personal data—to be collected, analyzed, and exchanged freely, across geopolitical boundaries, while minimizing risks and harms to individuals and enterprises globally. Existing regulatory approaches that are based on the principles of notice and consent to restrict the collection of data pre-designated as *personal* may overly restrict the supply of data available, hampering the foundation for the new economy. Furthermore, what is considered *personal* and *acceptable use* are individual decisions, subject to context, perceived value, and social and cultural norms—all of which are in a constant state of flux.

In reality, it is not the *collection* of data that is the source of potential harm, but its unconstrained use. Moreover, in the world of big data, it would be impractical, if not impossible, for individuals to give express consent for all the data that may be generated about them.

Together, the above factors necessitate a change in policy approach from a collection-based model toward a use-based model, where individuals give permission for the *use* of data related to them.

What is increasingly clear about an economy based on the collection, use, and analytics of big data is how little we actually know about it—its potential risks and rewards, as well as its implications for individuals, organizations, policy development, and growth. The rest of this chapter will focus on some core challenges that the authors believe could be particularly problematic—and that may threaten to impede the development of a promising 21st-century knowledge economy.

THE DEMISE OF FAIR VALUE EXCHANGE

All previous economic revolutions have been based on the idea of an explicit (i.e., transparent) fair value exchange. For example, in return for $850, early 20th-century consumers could obtain a 1909 Ford Model T; $1,565 bought a base-model 1981 IBM PC; and today, a hardback edition of Adam Smith's *The Wealth of Nations* is available for a price of about $17. The costs and benefits to those on both sides of this value equation (usually an individual and a corporation) are both clear and easily discoverable. The process by which the transaction is executed is well established in modern economics: rational, self-interested economic actors determine the price they are willing to pay for a good or service based on their subjective perception of its utility—something that is usually quite simple for them to determine. Assuming that the market in which the economic actors are engaging is not subject to monopolistic or other distortions, prices tend to settle at the point where supply equals demand.

Research sponsored by Microsoft and published last year by the International Institute of Communications found that, among other things, users *do* consider fair value exchange in allowing the use of their data.[11] They have some expectation of what they will receive in return—for example, discounts, better service, an improved product, or potential benefits to the larger community in which they live.

Retailer loyalty cards are an example of this type of transaction, and they also illustrate one of the challenges of the data-driven economy. Most consumers understand that the discounts they receive via a loyalty card are provided in exchange for data they supply to the retailer. But very few realize that the *primary* value to the retailer is the ability to track and analyze the spending patterns of both individuals and aggregated datasets of groups of consumers. In other words, significant information asymmetries are embedded in the transaction, and the average consumer lacks all the information required to make a rational decision about whether he or she should participate in it.

As the global economy becomes increasingly grounded in the exchange of data, the ways in which those data are collected and analyzed will become even more opaque to the consumer and the value exchange even harder to discern; trust will decrease correspondingly. An individual may have only a vague idea of what data exist about him or her and what is being done with these data. Some will have been actively volunteered by the consumer; some will have been obtained passively, with or without his or her explicit knowledge; and yet more may have been inferred by commingling a range of public and private, personal and non-personal datasets in ways that might expose new information or knowledge about each consumer's habits, lifestyle, health, or financial situation. Although the individual may receive something in return for this information, the real values of both the data provided and the service returned (in other words, the underlying exchange of value) may be almost impossible to determine.

Today little agreement exists about how best to value online data. The most comprehensive survey of valuation methodologies was presented in a recent OECD study (on which the authors of this chapter consulted) that identified numerous ways in which data *might* be valued in the market (refer to Box 1).[12] However, each of these methods has significant flaws, and none addresses the potential social and economic benefits of personal data. For example, corporate revenues per record/user are problematic because revenues contribute to economic growth only insofar as they generate added value (or surplus). Revenue of $4 per record/user with near-zero profitability is very different from $4 per record/user with 40 percent net profit. Similarly, the vast amount of personal data on Facebook have a relatively low per-person value because the company, while making significant profits from the sheer scale of its data holdings, has yet to find the Holy Grail of social-media data monetization. Amazon, by contrast, collects far less personal information from individuals, but its business model is predicated on advanced purchase analytics. Thus, on a per-user level, its inferred personal data (which are at present mostly outside the user's control) are more valuable than Facebook's volunteered personal data (which the user has painstakingly assembled, and over which she or he has at least nominal control).

Distinguishing personally beneficial uses of data from socially beneficial uses is a further challenge because each creates separate and significant value. For example, the *personal* value of using an electronic health record is improved treatment for the patient—and this undoubtedly has direct monetary value in the form of reduced costs, better outcomes, and so on. But *socially beneficial* uses also create (or could create) value—for example, by facilitating research into new drugs, identifying new epidemiological trends, or improving medical protocols. However, because the value created does not involve explicit market transactions, attributing this benefit directly to data involves some inspired approximation. And even though one estimate puts the savings in this case at up to US$300 billion,[13] most of the ways in which data are valued today would consider such benefits an externality to be ignored.

For many people, however, the various ways in which data *might* be valued are largely irrelevant today, because they have already given away their digital crown jewels for free. Individuals are passing massive amounts of personal and other data to large corporations with little or no thought to its potential monetary value—and those corporations are making significant profits as a result, because their cost of materials is essentially zero. The concept of fair value exchange no longer exists, at least not in any conventional sense. Facebook users, for example, provide it with data that have the potential to generate immense long-term value for the company; in return they receive a "free" service, but the transaction is wholly asymmetrical. As the computer scientist Jaron Lanier has observed, "[T]he dominant principle of the new economy, the information economy, has lately been to conceal the value of information…. We've decided not to pay most people for performing the new roles that are valuable in relation to the latest technologies. Ordinary people 'share,' while elite network presences generate unprecedented fortunes." And if an individual's information is not valued in economic terms, Lanier adds, "a massive disenfranchisement will take place."[14]

Box 1: Potential approaches for estimating the value of personal data

The following methods for valuing personal data have been identified, but each has important drawbacks. Possible approaches include:

- determining the market capitalizations of firms with business models predicated on personal data;
- ascertaining the revenues or net income per data record;
- establishing the market prices at which personal data are offered or sold;
- establishing the economic cost of a data breach;
- determining prices for personal data in illegal markets;
- reviewing economic experiments and surveys that attempt to establish the price companies would need to pay for individuals to give up some of their personal information; and
- ascertaining how much individuals would be willing to pay to protect their data.

Source: OECD 2013.

In other words, under the current model, the greater the role that data play in the global economy, the less the majority of individuals will be worth. This could mean that a data-driven economy may become a contracting economy. Like Lanier, we believe that if a truly sustainable data-driven economy is to be established, the way in which data are traded between individuals and corporations will require a major reset. For a data-driven economy to thrive, individuals would have to receive fair/appropriate monetary compensation for each specific datum they provide, perhaps with additional payments whenever that datum produces incremental profits for the entity to which it has been given (a concept popularized by Lanier). Such an arrangement would be complex: a specific datum might gain value only when commingled with other data, for example, and any payment/micropayment system would have to be capable of keeping track of such complexities (assuming the individual has given permission for this to happen). And a sustainable data-driven economy might also entail individuals paying fees (likely modest) for services they now consider (erroneously) to be "free."

Such systems, or similar approaches that address these concerns, will be essential to establish the concept of fair value exchange in the world of big data. The importance to our economic future—to the entire concept of a data-driven economy—of undergoing this evolution cannot be overstated. Without it, the consumers who today are the engine of economic growth will increasingly lose their ability to participate in the economy. Without fair value exchange for data along with inherent trust in the data ecosystem, everyone will ultimately lose—consumers, corporations, and countries alike. Establishing a system of fair value exchange will require new thinking on how technology *and* policy can work in parallel.

DESIGNING A TRUSTWORTHY—AND ECONOMICALLY VIABLE—DATA ECOSYSTEM

We believe that an essential element of the foundation that can enable user trust and fair value exchange is an interoperable metadata-based architecture. In such an architecture, data are logically accompanied by a "metadata tag" that contains references to the permissions and policies associated with the data, along with related provenance information, specified in an extensible and interoperable markup language. The metadata is logically *bound* to the data and cannot legally be unbound or modified for the entire data lifecycle by any parties other than the user or as specified by, for example, a related policy or rules of a "trust framework." More comprehensive consideration of these issues can be found in *Realizing the Full Potential of Health Information Technology to Improve Healthcare for Americans: The Path Forward* and the *Digital Enlightenment Yearbook 2013*.[15]

But the use of metadata does not stop at enabling the enforcement of user permissions and related policies. It can also be utilized to track and capture the *monetary value* produced by personal data, over time, in a decentralized data ecosystem—and consequently provides a foundation for both trustworthy data *and* fair value exchange. Consider: metadata enables individuals to change their personal data preferences and permissions over time, prevent undesirable use of previously collected data, address unanticipated uses, and adjust to changing norms. Thus, if we consider personal data to be the product of an individual's online "labors," and if we further consider that, in order to introduce the concept of fair value exchange (and sustainability) into a data-driven economy, those data must be assigned monetary value, then metadata is the mechanism that will enable individuals to "direct" their labors and reap the related benefits for the duration of its existence in the data ecosystem—enabling a more enlightened society in the digital space. How such an approach would incorporate machine-to-machine generation and use of data remains unanswered, however, and requires considerably more research.

Such an approach is technologically non-trivial. A primary challenge is security: although metadata can be logically *bound* to data, it can also be *unbound* by bad actors (a situation similar to the vulnerability of today's financial systems to hackers). Thus a strong legal and policy framework will be required to ensure that criminals are discouraged from doing this (again analogous to the laws governing today's financial systems). Another challenge lies in specifying the user permissions and policies that would govern how data can be used within—and shared across—trust boundaries, and how those permissions and policies would be negotiated among the multiple parties with claims on the data or claims to its monetary value.[16] Yet another, highly significant challenge is developing the appropriate interfaces that will enable individuals to specify their permissions, either directly or through other means (such as recommender systems or data intermediaries).

Achieving all this will require the specification of an interoperable metadata-based architecture that can function at Internet scale. The development of such an architecture needs to be a collaboration between multiple data stakeholders to ensure its feasibility and inherent security, as well as its ability to enable alternative policy frameworks.

A metadata-based architecture offers value to all stakeholders in the data ecosystem, not only users. Data controllers and processors can more easily understand and comply with permissions and policies defined for specific data. They can also establish a dynamic, economically viable and sustainable "marketplace" in data that would ideally mirror the way in which fair value exchange is established in the physical world. Solution providers can create applications and services that

produce new business value and track the associated value chain, yet still use data in privacy-preserving ways. Companies can develop metadata schemas that fully describe data use, codes of conduct, and relevant policies to meet industry and regulatory requirements. And regulators can take advantage of greatly improved auditability of data, along with a stronger and better-defined connection between the data and those policies that govern its use.

Although metadata can help facilitate a data-driven economy, it cannot *guarantee* that entities handling the data will honor the permissions and policies associated with them. However, when implemented as part of a principles-based policy framework that provides guidance on trustworthy data practices—supplemented by voluntary but enforceable codes of conduct and underpinned by legal redress—this is a flexible approach that holds the promise of satisfying the interests of regulators, individuals, and industry. In addition, as noted above, the authors believe that metadata could also be a key to establishing a viable and sustainable *economic* ecosystem in a data-driven economy, enabling the monetary value generated by data to be tracked, captured, and realized as payments to and from the ecosystem's participants.

CONCLUSION AND WAYS FORWARD

There are many challenges here, and today we have more questions than answers. But what is clear is that, in order to create a sustainable data-driven ecosystem, technology and policy must work symbiotically. For that to happen, governments and their regulatory representatives need to partner closely with industry, academic researchers, and consumer groups to gain a better understanding of the issues and to jointly develop innovative and evidence-based approaches to policy frameworks that address the above needs. Similar to evolution of new technologies, such approaches will need to be iterative.

Indeed, our view is that governments are the *only* entities with the ability to convene the broad societal coalition that will be required if the promise of a data-driven knowledge economy is to be fully realized. Such dialogues will, of course, need to be conducted on a global level.

NOTES

1 Machlup 1962.

2 Drucker 1969.

3 Ahmad et al. 2004.

4 Astrotic et al. 2002. Data are for value-added labor productivity.

5 Bughin and Manyika 2013.

6 Gens 2011.

7 Cisco 2013.

8 Ericsson 2011.

9 United Nations, Department of Economic and Social Affairs 2013.

10 Cisco 2013.

11 International Institute of Communications 2012.

12 OECD 2013.

13 Manyika et al. 2011.

14 Lanier 2013, p. 15.

15 See PCAST 2010 and Nguyen et al. 2013. When two or more entities agree to abide by a common set of legal rules, codes of conduct, other business and technical rules, and operational rules, they are generally referred to as belonging to the same trust framework.

16 In some respects, this is no more complicated than the agreements that have existed for years among telecommunications carriers—the scale and scope are different, the principles similar.

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CHAPTER 1.7

Building Trust: The Role of Regulation in Unlocking the Value of Big Data

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"Data is a precious thing. . ." and "…that's why I've called data the new oil. Because it's a fuel for innovation, powering and energizing our economy."[1] These were the words of Neelie Kroes, Vice-President of the European Commission responsible for the Digital Agenda, when speaking about the value of big data earlier in 2013. As Kroes noted, data comprise a fuel we have only just begun to tap.

This "new oil" is certainly plentiful. Trillions of bytes of data are generated by companies that capture information about their customers, suppliers, and operations. Networked sensors and software embedded in devices and appliances are further energy generators, as are the growing volumes of media content. These sources of data do not even include the billions of individuals around the world generating the same fuel on their smartphones, personal computers, and laptops. And the volumes of data are exploding. McKinsey recently estimated that the data collected globally will grow from some 2,700 exabytes in 2012 to 40,000 exabytes by 2020.[2] To put this into context, a single exabyte of data equals a hundred thousand times all the printed material of the Library of Congress.

Definitions of big data vary greatly. Rather than put a number on what qualifies as "big," McKinsey defines it as datasets so large that typical database software tools are unable to capture, store, manage, and analyze them. Such a definition allows for the fact that the size of datasets regarded as "big" will also grow with the advance of technology.[3]

Whatever the precise definition, big data is widely acknowledged to create value in four ways. It creates greater transparency by making more and better information available more quickly. It helps organizations create highly specific segmentations, enabling them to tailor products and services more precisely. It helps improve decision-making by providing better tools for analysis. And it supports innovation in the form of new products and services.

Big data can create significant value for the whole economy. McKinsey research shows that companies that use big data can deliver productivity and profit gains that are 5 to 6 percent higher than those of competitors. The private sector is not the only beneficiary, however. Big data can also enhance productivity and effectiveness of the public sector and create economic surplus for consumers. For example, the McKinsey Global Institute estimates that US healthcare expenditure could be reduced by 8 percent by using big data to drive efficiency and quality.

No wonder, then, that governments and political institutions are promoting big data on their agendas and adopting initiatives such as the European Union's open data directive, which aims to give both citizens and member governments access to a raft of government

Please note: The views expressed in this article are those of the authors and do not necessarily represent those of McKinsey and Company.

Figure 1: Consumers' privacy protection concerns

Sources: USC Dornslife/Los Angeles Times 2012; European Commission 2011.
* These data are taken from the Special Eurobarometer poll published in 2011. Respondents were asked to select 4 out of 12 possible responses to the question of what should happen to companies that breach protection rules. We present the top 3 responses here.

data. Governments understand that big data's economic and social potential can grow only alongside continued innovation in the underlying technologies, platforms, and analytic capabilities for handling data, as well as the evolution of behavior among its users. Recent McKinsey research shows that enabling "open data" or "liquid data" across seven domains—education, transportation, consumer products, electricity, oil and gas, healthcare, and consumer finance—can generate more than US$3 trillion in additional value a year.[4]

There is no guarantee, however, that this potential will be fully realized. Several obstacles lie in the way. The uptake of big data will depend on the adoption of next-generation telecommunications infrastructure, which is still in its early development in many parts of the world. Another prerequisite is a large enough pool of talent with the advanced analytical skills needed to put the data to good use. This workforce will need to be trained. Equally, big data uptake will hinge on whether ways can be found to protect information technology infrastructures and the data they carry from cyberattacks. A further imperative is to build the trust of citizens, who are growing increasingly suspicious about how information about them is being used.

Regulation plays a role in tackling all these obstacles. This chapter focuses only on the need to build trust. It examines the various broad types of regulatory frameworks that are emerging to protect privacy. Furthermore, it identifies the key issues that regulators will need to consider as their policies evolve if their aim is to foster trust while not stifling the enormous potential of big data, and it outlines some actions companies can take themselves to promote consumer trust.

CONSUMER TRUST AS AN ENABLER OF BIG DATA

Research reveals that consumers are increasingly concerned about how their personal data are used (Figure 1), although the level of concern varies according to the type of data being considered. Consumers care more about their financial transactions and health-related information than about their online habits, for example. The recent revelations by Edward Snowden disclosing US government data collection practices and the extraction of data from a number of large Internet companies have further raised public awareness about privacy issues and data protection in the online world.

If big data is to deliver on its promise, companies will need both to create customer trust in big data applications and their use and to help customers feel safe about the protection of their personal data and privacy. Governments and regulators will need to frame data protection policies that safeguard the privacy of both customers and citizens. At the same time, these policies must not stifle the innovation that big data can deliver, or its attendant economic and social benefits.

DATA PROTECTION ARCHETYPES ACROSS THE WORLD

The protection of personal data has long been viewed as a fundamental right, enabling individuals to be in control of data about their own person and preventing unnecessary listings and discriminatory behavior. Individuals can exercise this control by explicitly giving or withholding consent before their personal data are

used. They have a right to be informed if those data are to be used, and for what purpose. Companies and organizations using their data are also required to protect it from unauthorized use. There are strict measures in place to protect medical data and credit information.

But the issue has become more complicated in the Internet era. Some argue that this right should be safeguarded more strongly than ever when so many companies and organizations are seeking access to personal data and can gain that access more easily. On the other hand, as we have seen, economic, social, and personal benefits can arise from sharing data, and many consumers are perfectly happy to give up some of their privacy in return for certain goods or services.

Data protection laws are evolving not only in an attempt to keep pace with technological developments and new ways of using, collecting, and sharing personal data, but also to keep pace with attitudes toward privacy. To better understand the state of play, McKinsey has conducted extensive research into the data protection regulatory frameworks of more than 20 countries worldwide, identifying the key principles and requirements (Figure 2).

From our research we have identified three main archetypes of the level of regulation imposed around the world: from the least to the most extensive, these are regulations with a light touch, those with a minimum standard, and those with strict ex-ante requirements.

- **Light touch/self-regulation.** This is the approach used in the United States, where there is no general federal data protection law. Instead, different sectors—such as healthcare, telecommunications, and finance—are regulated by specific laws applying only to these sectors. These laws are enforced by sector-specific authorities. Separate states can also stipulate their own general regulations. Generally the onus is on industries and the companies within them to build trust with their customers, either by issuing and following codes of conduct or via contractual arrangements. Companies are responsible for the privacy statements issued to their customers and can face judicial sanctions for non-compliance. Facebook and Google are two recent cases in point.[5]

- **Minimum standard setting.** In Asia, the Asia-Pacific Economic Cooperation (APEC, a forum of 21 Asia-Pacific economies) has developed a self-regulatory framework setting out the principles that economies should implement and companies then follow to ensure a common, minimum level of data protection across member economies. The aim is to enable the easier transfer of data among economies where the level of data protection regulation varies greatly. Although some Asian economies (such as Pakistan) still lack data protection laws entirely or have recently introduced them (e.g., China and India), others—such as Japan—have well-developed laws. Examples of minimum-level principles are the requirement that individuals (where appropriate) should be able to exercise choice about the collection, use, or disclosure of their data, and that the data collected should be accurate, complete, and up to date.[6]

- **Strict ex-ante requirements.** Ex-ante requirements apply in Europe, where both the Council of Europe and the EU Commission have developed extensive frameworks to protect data and privacy in their respective member countries.[7] These frameworks not only define what is regarded as personal data and how such data can and cannot be used, but they also set organizational and technological requirements. Companies should, for example, implement technological and organizational measures to protect the data gathered. Furthermore, strict liabilities are in place relating to both companies and cooperation frameworks for regulators. The frameworks stipulate that data from the European Union may be transferred only to countries that have an appropriate level of protection.[8]

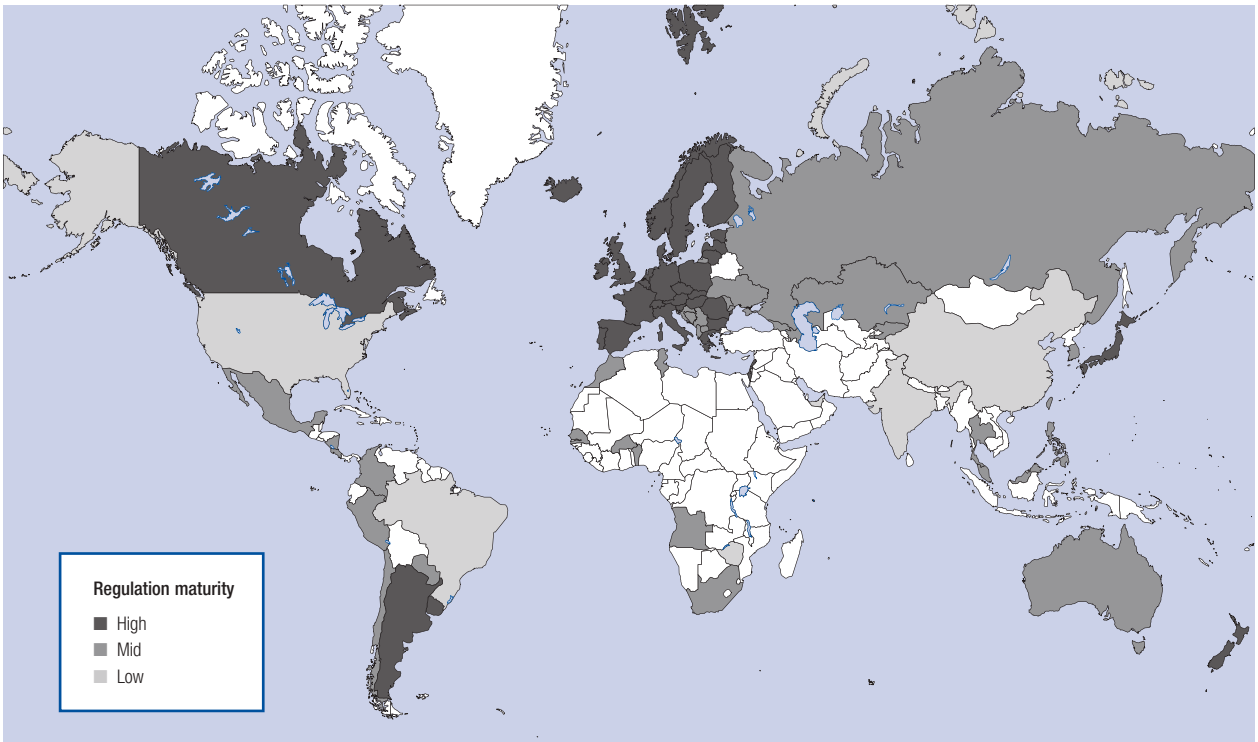
All three regulatory archetypes are constantly evolving. One example of this evolution is that the European Union is currently updating the existing data protection directive from 1995 to better meet the requirements of today's data-intensive world.[9] In the United States, the Federal Trade Commission (FTC) has increased its focus on data protection issues and has published several reports and recommendations on the topic in the past few years. It has also taken on a stricter role regarding the enforcement of companies' own privacy statements.[10] The APEC framework was set up in 2004 and has evolved over the past 10 years.

Opinions on the best approach to data protection and privacy regulation differ. Some experts argue that it is better to adopt a light-touch approach in a technologically dynamic world because detailed, specific regulation could quickly become obsolete and even hinder technological and business development. Others argue that increasingly powerful technology makes a stricter regulatory approach necessary to protect privacy. Whatever approach is taken, we believe data protection and privacy regulation is becoming more and more important across the world, and countries and companies need to embrace it to create competitive advantages for them in the future.

KEY REGULATORY AREAS FOR BIG DATA UPTAKE

Whatever approach any single government or regulator chooses to adopt, all will need to pay particular attention to key areas that require further clarification to support the kind of innovation and prosperity that big

Figure 2: Variation in data protection regulation across markets



UNITED STATES

No federal law exists to date

Some state- and sector-specific laws have stricter regulations

Case-by-case enforcement of privacy statements

SOUTH AMERICA

Tradition of "habeas data"—the right to find out if personal data is processed and the right to file a complaint if it is misused

After amendments, regulation in Argentina and Uruguay is at the EU level of strictness

No specific data protection law exists in Brazil, but the country has constitutional protection and sector-specific data protection legal provisions

EUROPEAN UNION

Existing regulation is already the strictest globally

Regulations cover all industry sectors

Regulation requires "adequate protection"—that is, the same level of protection for transmission to third countries

A safe harbor agreement with the United States enables free data transfer between compliant companies in the two regions

RUSSIA AND CENTRAL ASIA

Data Protection Acts exist in some countries (Azerbaijan, Georgia, Russia, Ukraine)

Enforcement is low (relevant mechanisms and authorities are not always in place)

MIDDLE EAST AND AFRICA

A few countries (Morocco, Tunisia, the United Arab Emirates) already have data protection laws

Morocco signed the Council of Europe data protection convention in 2013,* establishing a general data protection regime

Most countries are unregulated or have single points in sector laws (e.g., Algeria, Egypt)

ASIA PACIFIC

The level of protection ranges from strong protection in Japan and the Republic of Korea to weaker protection in Bangladesh, China, Pakistan, Indonesia, for example

Recent awareness of data protection issues has resulted in several new laws in economies such as India, Hong Kong SAR, the Republic of Korea, and Singapore, as well as other efforts, such as the APEC Cross-Border Privacy Rules System, enhancing protection

Sources: Council of Europe 2013a, b; European Commission 1995, 2002, 2012; IAPP 2013a, b.

* The convention was initiated and signed by Member States of the Council of Europe in 1981. See Council of Europe, Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (ETS No. 108), available at http://conventions.coe.int/Treaty/en/Treaties/Html/108.htm.

data can drive, while maintaining customer trust and data protection. These areas include: consent before collection, a definition of *personal data,* anonymization, the right to be forgotten, relevant jurisdiction, and liability issues. Each of these key areas is discussed below.

Consent before data collection. A key principle in the European regulatory framework is the need to obtain personal consent before data are gathered. Anyone wanting to use an individual's data must first seek his or her permission. But with so much information now available and being gathered, seeking that approval can be a slow, tedious process for companies and consumers alike and can hinder big data development. Cookies on the Internet are a simple example. Surfing the web would be more convenient without cookie notifications and approvals. The APEC framework recognizes this, and the framework states that "where appropriate, individuals should be provided with . . . mechanisms to exercise choice in relation to the collection, use and disclosure of their personal information."[11] However, determining where such choice is appropriate is open to interpretation.

The definition of personal data. The suggested EU framework defines *personal data* as "any data that can be attributed to an identifiable person either directly or indirectly." The APEC framework describes *personal data* as "information about an identified or *identifiable* individual." Both these definitions mean that not only data clearly identifying a person with information such as a name or address is considered to be personal data, but also data that can be attributed to a person indirectly through some other measure, such as via a mobile phone number or an identity code. In a big data world where a lot of data are interlinked, it can be difficult to know exactly when data become "personal." Is it only data that identify a person with certainty, or does it also include data that identify someone with high probability? How about a person's actions? Performance? Or buying behavior? To give a concrete example, a US retail chain identified new parents as a very lucrative market segment. The chain analyzed their customers via characteristics such as their shopping habits, age, or marital status to spot customers who were pregnant. They then sent those customers direct marketing material for their baby products ahead of their competitors, who sent their material only after the child's birth.[12] However, information on pregnancies is extremely sensitive, and such material could risk disclosing a pregnancy that has not yet been announced. This could clearly be seen by some as an intrusion of privacy, but the issue is not entirely clear from a legal perspective.

Anonymization. Closely linked to the dilemma of how to define which data are personal is the issue of data anonymization or sanitization. Traditionally, anonymous data have not been subject to data protection laws. However, in a big data world where anonymized data can easily be linked up, it is not very hard to build a profile of a person without traditional means of identification such as a name or address. For example, a team at Harvard was able to identify individuals from anonymized data in a genetics database by cross-referencing it with other public databases. The accuracy rate was 42 percent based on the use of only three types of information—zip code, date of birth, and gender—and rose to 97 percent when the first name or nickname was added.[13] Another example is the use of de-anonymization tools by researchers from Texas University on 500,000 Netflix users who had anonymously voted for their preferred movies back in 2007. In this case, the researchers also managed to identify users by linking the anonymized ratings with another public database with movie ratings.[14] It can therefore be argued that the use of anonymous data can potentially constitute an intrusion of privacy.

Another question related to data anonymization is the right of companies to use the personal data already in their possession and turn them into anonymized data that they sell to others. Some companies are selling their customer data—such as location and application data of telecommunications companies—to other companies in anonymized and aggregated form for marketing purposes. Companies can target their marketing more effectively by using these data to learn about their customers. Internet companies are also matching their customer data and online habits with data from other companies to better target their online advertising.[15] Several questions arise from a privacy perspective. When can data be considered anonymized? Does using a pseudonym make data anonymous? Are companies allowed to use anonymized data without the customer's consent, or must customers give their prior approval? Should that consent be granted before use, or is it enough to allow customers to opt out?

The right to be forgotten. The new EU data protection framework proposes introducing a right for users to request that data controllers remove their personal data from their files. Although on paper it sounds easy to remove personal data relating to an individual upon request, this may not be so easy in the real world. The European Union Agency for Network and Information Security (ENISA) states that a great deal of data are stored in different places in the cloud for security reasons, and these data may have been aggregated or amended into new forms, such as statistical data. Thus removing some specific data from all systems upon request may be entwined with the aggregated data. Clearly this is not such a straightforward task in a virtual environment, and there is no single technical method to enable this easily.[16]

Relevant jurisdiction. Data are increasingly used and stored across borders, but regulation is still largely national in its scope and regulators lack jurisdiction in markets outside their own. The uncertainty about jurisdictions creates problems for companies and

consumers alike. Which regulations apply to companies from another country? Which judicial authority has the right to intervene in disputes? What happens in cases where a company breaches laws across many markets? In its recent proposal on the new EU data protection regulation, the European Union extends the applicability of its regulation to companies outside the European Union that are handling data relating to European Union–based individuals.

Liability issues. In today's world, companies often cooperate to produce big data applications and solutions. One company orders software from another, which in turn uses a third company as a contractor, which stores its data within a cloud service operated by yet another. If data are leaked, it can be very difficult to decide which company is liable.

The above remaining gray areas must be considered and clarified so that both consumers and companies using big data clearly know what the rules are in order to ensure a certain environment that is conducive to investment and market growth. In the next sections we propose several options for regulators and companies to make the big data environment more certain.

IMPLICATIONS FOR REGULATORS AND POLICYMAKERS

Regulators will need to address all the above issues when shaping their personal data protection policies. Although not prescribing any single solution, certain principles will help guide regulators in their deliberations and ensure the necessary regulatory balance. These principles include the need to establish regulatory stability, cooperation with members of industries and different countries, and promoting industry self-regulation. Each of these principles is discussed below.

Regulation in any field always works best if it creates a stable environment in which companies and other organizations can operate. When it comes to data protection, companies and other organizations will need regulatory certainty if innovation is to be encouraged. Providing that stability is likely to be easier if regulators focus not on specific regulations that may quickly become obsolete, but instead on establishing non-discriminatory technology-neutral high-level regulatory principles that last.

Regulators should cooperate with companies and other stakeholders within the industry when revisiting their regulatory frameworks. This will help to understand the business issues and allow them to be at the forefront of developments without hampering industry development.

Regulators should also cooperate internationally to establish common international norms and clarity around applicable legislation. International discussions are already taking place on specific issues. Regulators in the European Union and the United States have a safe harbor framework, for example, that allows US-based companies to transfer data between the two regions without further approval from EU-based regulators. These safe harbor provisions are currently being revisited. US and Asian regulators are cooperating around the APEC framework; the United States is the first non-APEC market to sign the minimum standard framework. An even a wider take on data protection issues in the big data environment would be beneficial for all parties.

Whatever their approach to regulation, governments should promote industry self-regulation. Self-regulation is the best way to achieve a commonly accepted code of conduct for a specific industry. This has already been done in specific areas—for example, the use of personal data in mobile marketing—but so far efforts have occurred mainly at the country level, in markets such as the United States and the United Kingdom. An international industry standard specifically concerning the use of personal data protection in big data would certainly be beneficial to establish a higher level of trust among consumers and create a clear data protection standard for companies. The weakness of industry self-regulation is obviously enforcement, because self-regulation is not normally legally binding.

By efficiently managing all stakeholders, regulators can establish a transparent legal framework that helps promote industry growth rather than hindering it with unnecessary legal burdens.

IMPLICATIONS FOR COMPANIES

The onus is not just on regulators to build an environment of trust where citizens feel their privacy will be properly protected. Companies also have a key role to play. If they develop an efficient data protection strategy, companies may also gain competitive advantage in the form of cost savings, organizational efficiency, and—importantly—reputational advantage. To maximize the benefits of big data and to build trust, a number of actions could be considered.

The first action a company should take is to assess its regulatory and operational starting point. Understanding customer concerns and regulatory issues early will help companies determine the areas of risk they need to start tackling. It will also outline the company's strengths and determine the best way to leverage those strengths to develop their big data strategy. For example, a company may wish to build on its reputation as a reliable company that safeguards customers' personal data or position itself as an innovative company with cool services based on its users' behavior and habits or preferences.

A company should also build a privacy-by-design mentality. It goes without saying that companies will need to comply with relevant regulations. But gaining consumers' trust is a question of mentality, too. Many companies may find they need to implement changes across the organization as well as in relevant processes and technology applications to protect consumer privacy.

Companies should strive to make data protection part of the company culture. They can avoid costs occurring at a later stage (when compliance measures are needed) by implementing data protection in their processes from the start.

Companies must also cooperate with regulatory authorities. Privacy and data protection regulation is constantly evolving. This means that companies will need to establish a close relationship with national regulators to ensure compliance and to make certain that the regulators and policymakers understand the business issues at hand and the benefits of big data for society.

Furthermore, companies need to cooperate with other industry participants. Cooperating to develop industry-specific norms and standards will help to create an industry norm that enables consumers to have greater trust.

Importantly, companies also should empower customers. Customers' concerns about privacy are often alleviated if they are able to make their own decisions about what data they do or do not share. Providing transparent privacy policies or simply informing the customer of the scope of data handling as well as requesting clear consent declarations from customers also helps create customer trust without sacrificing big data business opportunities. Technological tools help, as they can allow customers to adjust their privacy settings and choose whether to opt in or out of services. One example of this is British Telecom's cookie settings, which allow the customer to set the level of cookies allowed and choose the level of privacy they are ready to sacrifice for better services or service quality.

Companies have a key role to play in creating consumer trust. Success in this area is not only about managing regulators and compliance, but also about creating a reputation as trustworthy and reliable in terms of both secure operations and fair commercial practices. As mentioned in the beginning of this chapter, customers are usually willing to share personal data if the value of the service is attractive enough and the customers feel they get more in return than they give up.

CONCLUSION

Big data offers a wide range of opportunities—not just for individual companies, but also for nations and society as a whole. Both regulators and companies have large roles to play to ensure positive development in this emerging market with such great potential.

Regulators and policymakers should respond swiftly to regulatory and policy concerns regarding big data development. They must enable fast network build-out. They must also ensure the education and training of a qualified workforce and safeguard Internet safety. And they must address consumer disquiet about privacy and the protection of personal data—an area where several issues are unclear and require further consideration and clarification, ideally in cooperation with players across the industry value chain and at an international level.

Above, a number of suggestions about how companies might respond to these concerns were outlined. Initially companies should conduct an assessment of their regulatory and operational status quo to identify risks and opportunities. They should consider implementing a privacy-by-design mentality to avoid unnecessary costs while ensuring compliance. Companies should also consider cooperating both with regulators and others within their industry to create trust of their specific sector. Key for gaining customer trust will, however, be the empowerment of customers by clearly communicating their privacy policies to them, giving them options for their privacy settings, and requesting consent declarations. Companies need to ensure that their customers understand what choice means in terms of service performance and make sure their services are providing more value to the customer than the loss of privacy is worth.

It is only by addressing customer concerns at different levels within the industry that the big data industry can eventually evolve to its full potential.

NOTES

1 Kroes 2013a, b.

2 Lund et al. 2013.

3 Manyika et al. 2011.

4 Manyika et al. 2013.

5 FTC 2010–14; see www.ftc.gov/opa/reporter/privacy/privacypromises.shtml.

6 APEC 2005.

7 Council of Europe 1981; European Commission 1995, 2002.

8 European Commission 1995.

9 European Commission 2012.

10 FTC 2010-2014; see www.ftc.gov/opa/reporter/privacy/privacypromises.shtml.

11 APEC 2005.

12 Duhigg 2012.

13 Sweeney et al. 2013.

14 Narayanan and Shmatikov 2008.

15 Steel 2012.

16 ENISA 2011.

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CHAPTER 1.8

From Big Data to Big Social and Economic Opportunities: Which Policies Will Lead to Leveraging Data-Driven Innovation's Potential?

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Over the last few years, myriad examples of innovation in data analysis have emerged, creating new business models for data-driven innovation. For example, businesses are developing ways for real-time weather information to be communicated to devices in the field that can advise farmers on pest activity, water supply, and inclement weather.[1] The Royal Netherlands Meteorological Institute has found a way to generate extremely accurate rainfall information using nothing more than existing data from cell-tower installations.[2] The next phase of the Internet's evolution has us on a clear path toward a "revolution of data."[3] Every year, the costs associated with the production, collection, storage, and dissemination of data come down, making those data more readily available. This process is fomented by the increasing migration of many social and economic activities to the web.[4] More data are generated today than ever before; this is a positive trend that will inevitably continue: 90 percent of the world's information generated through the history of mankind has been generated over the last two years,[5] while data generated per year is growing at a rate of 40 percent.[6]

In this chapter we will focus on the social and economic value of data, but from the point of view of use and purpose rather than volume. We will therefore talk about data driven-innovation instead of "big data," and will provide case studies from different areas, with a special consideration of how data-driven innovation in the public sector could improve policymaking. We will finish the chapter by describing the main issues that should be addressed by policymakers, who can leverage the potential of data-driven innovation in their communities through forward looking policies.

WHY SPEAK OF DATA-DRIVEN INNOVATION INSTEAD OF BIG DATA?

It has become axiomatic that more data are produced every year, and somehow this phenomenon has driven commentators to call this revolution "the age of big data." However, what is commonly known as big data is not a new concept, as the use of data to build successful products and services, optimize business processes, or make more efficient data-based decisions already has an established history. Innovative uses of data have been key to developing new products and making more efficient decisions for quite a long time, and these activities have become more common and more efficient with the availability of modern computing. Crunching data, statistics, and trends in new ways has always helped change the way that entire sectors operate. Agriculture is one of the first major sectors to have benefitted from the aggregation and analysis of data: in 1793, the *Farmer's Almanac* found a

The opinions here are the views of the authors and do not represent the views and positions of their employer.

niche when it published its first report more to provide landowners with guidance for what they might expect in the coming year and to plan their crops accordingly.[7] It took 183 years for paper-based, manpower-intensive analysis to become automated, but in 1950, a team of meteorologists used the Electronic Numerical Integrator and Computer (ENIAC) computer to make the first successful numerical weather prediction.[8]

Moreover, the term *big data* is ambiguous, and it sets up data as a negative because of the implication that "big" is "bad." Indeed, many common definitions of big data usually focus not on size but instead on various characteristics, including the frequency of production, speed, volume, variety, and capacities needed to manage and process information.[9] McKinsey, for example, describes *big data* as "datasets whose size is beyond the ability of typical database tools to capture, store, manage and analyze."[10] The implications of this definition are that the main features of big data (quantity, speed, variety) are technical properties that depend not on the data itself, but instead on the evolution of computing, storage, and processing technologies.[11] What may look like big data today will not likely be as "big" in the near future.

Thus, what is important about data is not their volume, but how they may contribute to innovation and therefore be used to create value. Data alone do not possess inherent value; instead it is the processing of data in innovative ways that brings new economic and social benefits, and this value creates a virtuous circle to feed into more use of data-based decision-making and analysis.[12] In other words, it is the use of data that really matters.[13] One way to measure this value is to measure the socioeconomic metrics (or to estimate the future potential) obtained from the use of data. The excitement that we are seeing with new deployments of data to fuel innovation is not just because of the volume of data, nor is it about the data themselves. As pointed out by the Software and Information Industry Association, "transformative data can be big or small or even the 'needle' of data found in a giant haystack."[14]

The truth is that data are data, and that has not changed for centuries. When "big data" is no longer a trendy concept, data will continue to drive innovation, and solutions for new problems will come from new ways of analyzing and interpreting data, regardless of volume or our technological capacities to manage it. In the next section, we will address what we see in the future for data-driven innovation.

THE BENEFITS OF DATA-DRIVEN INNOVATION

Many sectors benefit from data-driven innovation: healthcare (e.g., diagnosis and treatment), financial services (e.g., analyzing market trends and economic conditions), and transportation and public administration (e.g., metrics on what citizens want and where economic development is headed), to name a few. In one example, a philanthropic research center stores and analyzes the cancer genome and the sequences and mutations of more than 10,000 cancer cases to understand the complexity of the disease.[15] In another recent project, a university-based group of academics mined data from 60 years of historical weather records to identify the factors that are most predictive of hurricane activity.[16] In the private sector, PayPal has developed a system that screens payments and combines them with IP addresses, browser information, and other technical data to identify and prevent fraudulent activity in online payments, bolstering trust for commercial exchanges on the Internet.[17] A startup firm has developed a no-cost platform for users that helps travelers predict flight delays using an algorithm that scours data on every domestic flight for the past 10 years and matches it to real-time conditions.[18] Finally, the United Nations is working with governments around the world to understand global trends related to hunger, poverty, disease, and job loss.[19]

However, because data-driven innovation takes place across various sectors of the economy and society, it is sometimes difficult to quantify its full economic impact. For example, using any traditional measure of Gross Domestic Product (GDP), Wikipedia does not contribute any economic value.[20] This makes no sense in today's world, as economists are now demonstrating that a fundamental problem exists in our ability to quantify the value of data, and this gap misleads policymakers in their drive to maximize economic surplus.[21] As Michael Mandel has observed, "economists have been systematically trained to think of the economy as divided into two big categories: 'goods' and 'services.'"[22] Data are neither a good nor a service and so they escape traditional economic analysis. This highlights the complication of discussing data: although the value often creates an economic reward, such measurements are not easy to make. The Internet itself has been a strong contributor to economic growth for more than two decades, but only in the past couple of years have economists undertaken serious attempts to quantify the Internet's impact on the world's economies.[23]

One example of innovative data use that has a difficult-to-quantify economic value proposition is Google's Flu Trends, which provides near real-time estimates of flu activity for a number of countries around the world. Flu Trends provides its analysis based on aggregated search queries.[24] Some of these estimates have been compared with official historic influenza data from relevant countries with surprisingly high levels of accuracy, and in some cases Flu Trends provided information weeks ahead of official records. In the case of H1N1, the world's citizens were searching online long before official statistics were available.[25] Additionally, the data from Flu Trends are open, available for everybody

to download and use. A group of researchers from the Johns Hopkins University, for example, used these data to develop a practical influenza forecast model designed to provide medical centers with advance warning of the expected number of flu cases, thus allowing sufficient time to implement interventions before outbreaks.[26] This example illustrates how the openness and accessibility of data are crucial to keeping the wheel of innovation rolling by allowing others to access and manipulate the data in transformative ways.

Similarly, the rapid collection and processing of information has helped in recent natural disasters. After a devastating earthquake hit Haiti in 2010, a group of researchers from the Karolinska Institute and Columbia University analyzed calling data of over 2 million mobile phones to detect the pattern of population movements across the country. This information was then handed to humanitarian agencies to allocate relief resources in a more efficient way.[27] The findings of the project, called Flow Minder, suggest that population movements during disasters may be more predictable than had previously been understood.[28]

These examples show that there are ethical and responsible ways of analyzing big sets of data and equally ethical and responsible ways of using them to provide high-value solutions for citizens, whether or not they have a clear quantifiable economic value at the outset. More efficient preparation for outbreaks and better understanding of post-disaster movement ultimately mean more cost-effective deployment of public services.

High-value products and services and more efficient deployment of resources are not the only outcomes of data-driven innovation. Studies suggest that there is a direct connection between data-driven decision-making in business and improved firm performance. Firms that adopt data-driven decision-making have an output and productivity that is 5 percent to 6 percent higher than would be expected, given their other investments and their information technology (IT) usage.[29] Another study has shown that the use of Internet computing tools can also help firms reach decisions more efficiently, across a broad range of industries, as they allow firms of all sizes to leverage data-driven analysis without needing to make huge investments in their IT infrastructure.[30]

As is the case for businesses, policymakers are entrusted to make decisions for the citizenry with very little information. Politicians recognize the need to base their recommendations on objective information, and they are expected to move quickly, just as business managers are.

In fact, the public sector is one the most data-intensive sectors of all. According to McKinsey, the US government had over 848 petabytes of data stored in 2009—second only to the manufacturing sector.[31] What is usually known as "data-driven policymaking" involves the collection of information related to how roads are traveled, to determine trends in utility consumption and the provision of government services (Box 1), and to promote creativity and new ideas within government agencies.[32] Statistical agencies inside of governments, such as census departments, have long been established to maintain data about the nation. Thus data-driven policymaking is not new, but the opportunities brought by the advances on information and communication technologies make data-driven policymaking increasingly accessible to government officials. Further, open government initiatives put these data into the hands of the public, facilitating a new kind of transparency and civic engagement for curious and interested citizens. Data can benefit society when they are open.[33]

By providing a way to check assumptions, detect problems, clarify choices, prioritize resources, and identify solutions, data-driven policymaking injects data-based rationality into the policymaking process, all of which could also create economic benefits.[34] According to the Organisation for Economic Co-operation and Development (OECD), by fully exploiting public data, governments in the European Union could reduce administrative costs by 15 percent to 20 percent, creating the equivalent of €150 billion to €300 billion.[35] In other words, data-driven policymaking moves policymaking out of the realm of intuition and dogma by creating a sound evidentiary basis for decisions.

However, studies suggest that the public sector still does not fully exploit the potential of the data it generates and collects, nor does it exploit the potential of data generated elsewhere. The "revolution of data" still needs to make its way within government agencies. Although the government is one of the sectors with the greatest potential to capture value from data-driven innovation, it also has one of the lowest productivity growth rates because it lags behind business and industry in fully embracing data.

Box 1: Hong Kong Efficiency Unit

The Hong Kong Efficiency Unit acts as a single point of contact for handling public inquiries and complaints on behalf of many government departments. After collecting thousands of complaints each year, its staff recognized the social messages hidden in the complaints data, which in fact provided important feedback on public service. Using a platform called the "Complaints Intelligence System," they now use the complaints information collected to gain a better understanding of daily issues by uncovering trends, patterns, and relationships inherent in the complaints.

Source: Government of the Hong Kong Special Administrative Region, Hong Kong Efficiency Unit, 2013.

Box 2: Harvard Transparency Project

The Transparency Policy Project at Harvard's Kennedy School studied the relationship between transit data format and accessibility and the number of applications for that system. Of the five transit agencies they studied, the TriMet in Portland, Oregon, and the Massachusetts Bay Transit Authority (MBTA) in Boston have generated the highest ratio of applications per transit rider (1 to 7,000 and 1 to 27,000, respectively). Meanwhile, the most reluctant agency to adopt open data, Washington DC's Metro, had only 10 applications serving its customers in 2012 (1 to 121,400).

Source: Rojas, 2012.

SETTING THE STAGE FOR A DATA-DRIVEN ECONOMY

Apart from producing and using data for better policymaking processes, the public sector can also play its part by promoting and fostering data-driven innovation and growth throughout economies. To realize the potential of data-driven innovation, policymakers need to develop coherent policies for the use of data. This could be achieved by: (1) making public data accessible through open data formats, (2) promoting balanced legislation, and (3) supporting education that focuses on data science skills.

Open data initiatives

The use of data across sectors can drive innovation and economic growth. However, many generators of data—including governments—do not share their data. As we have seen, the public sector is one of the main producers and collectors of data. Open data initiatives that make data in the public sector accessible to everyone contribute to data-driven innovation and create value for governments. For example, aggregate public transport data may be used by developers to create useful applications for passengers (see Box 2). This access to real-time information could result in a greater number of passengers and, subsequently, to more income for the transport authorities. In addition, accessible public data usually lead to better data because data users can test structure and help to fix mistakes (see Box 3). Improvements in the quality of data mean better data-based solutions and, ultimately, better policy.

It is important to note that opening up public data does not necessarily lead to the disclosure of personal data. Public data that may contain personal information of citizens should be shared in an aggregate or fully de-identified way to protect citizens' privacy. We will go into more detail around the discussions on privacy and personal data in the following section.

How to get the best of data-driven innovation

The increasing ease of linking and analyzing information usually raises concerns about individual privacy protection. Personal data are the type that has drawn the most attention, from a regulatory point of view, in relation to data-driven innovation. The challenge is to achieve a reasonable balance between individuals' right to privacy and the emerging opportunities in data-driven innovation.

For this reason, in order to capitalize on opportunities for economic growth via innovation, flexible and adaptable policies are needed. We need to focus on using datasets responsibly and ensuring that personally identifiable information is accessible only by those who are authorized to do so, without limiting innovation. In other words, privacy protection frameworks should support secure and reliable data flows while enhancing responsible, risk-reducing behavior regarding the use of personal data.

Legislation should take into account the tension between data-driven innovation and the principle of data minimization. This principle essentially states that the collection of personal data should be limited to what is relevant and necessary to accomplish a specific purpose, and for only as long as necessary. This tension usually materializes in two regulatory discussions: first, the definition of *personal data;* and second, the model of consent by users. These considerations are both critical, but framing things in this way leads to the inevitable conclusion that fewer data are better.

A key dividend of data-driven innovation is the possibility of finding new insights by analyzing existing data and combining them with other data. This can sometimes blur the lines between personal and non-personal data, as well as the uses for which consent may have been given.[36] A practical definition of *personal data* should be based on the real possibility of identifying an individual during the treatment of data.[37] This is why applying existing approaches to personal data may result in overly broad definitions that can have unintended negative consequences for data-driven innovation.

For the same reason that combining and correlating datasets is a key feature of data-driven innovation, the full potential of data collected may not be clear at the time of collection. A consent model that is appropriate to the data-driven economy should provide a path for individuals to participate in research through informed consent. In this model, they would become aware of the benefits of their participation as well as potential privacy risks. For this reason, the legislative considerations for data collection should not assume that less is always more and should take into consideration the data-intensive direction of some of the economy's growing sectors.

Building skills for the future

An economy where both the public and private actors who base their decisions on data analysis will demand highly skilled workers with backgrounds in

Box 3: Can open data lead to better data?

Moscow's city government published about 170 datasets with geo coordinates at the Moscow opendata portal. After examining the data, Russian members of the OpenStreetMap community found many errors and mistakes, including wrong geo coordinates. After publishing their research, most of the issues were solved by Moscow state officials.

Clinicians from the Imperial College London, while reviewing open statistical data from the United Kingdom's National Health Service, found that records said that 20,000 male patients required midwifery services between 2009 and 2010. After this research was published, data systems were improved.

Source: Open Knowledge Foundation, 2013.

data analysis, information science, metadata and data visualization. The demand for engineers who specialize in technologies such as machine learning and natural language processing will also increase, and a gap between the supply and demand for these types of skills may hinder data-driven innovation's full potential. The United States itself will need up to 190,000 more workers with deep analytical expertise by 2018.[38] This clear demand for skilled workers is further evidence of data-driven innovation's potential benefits for economies.

CONCLUSION

We have already begun to see the impact technology has had on the volume and speed at which data may be generated, analyzed, and put to use. Thirty years ago we needed an army of data-entry clerks to feed an information into a system; today, the information is already available in a machine-readable format. We carry devices with sensors that can provide incredible amounts of information in real time. Every day, the world adds petabytes of information into social networks and other Internet platforms.

Talking about this phenomenon as "big data," however, misses the true potential of data. Instead, we should focus our discussion on *data-driven innovation,* as this relates to the results and outcomes of data use—from generating innovative products and service to improving business and government efficiency. Many other examples provided earlier have shown that data-driven solutions have transformative social impact as well.

However, achieving the full potential of data-driven innovation demands challenging the outdated paradigms established in a significantly less data-intensive world. To achieve the maximum benefits from data-driven innovation, policymakers must take into account the possibility that regulation could preclude economic and societal benefits. Decisions that affect data-driven innovation are usually focused on the problems of privacy and data protection, but fail to consider economic and social benefits that regulation could preclude. It is by looking at the big picture surrounding big data that we can create the right environment for data-driven innovation, and that the individuals, organizations, and economies that may benefit from it can thrive.

NOTES

1 Gray 2013.

2 The Economist 2013a.

3 Mayer-Schonberger and Cukier 2013.

4 OECD 2013.

5 IBM 2013.

6 Manyika et al. 2011.

7 The Old Farmer's Almanac, no date, "History of the Farmer's Almanac."

8 Platzman 1979.

9 Hemerly 2013.

10 Manyika et al. 2011.

11 OECD 2013.

12 According to Hilbert (2013, p. 4), "the crux of the 'Big Data' paradigm is actually not the increasingly large amount of data itself, but its analysis for intelligent decision-making."

13 Hemerly 2013.

14 SIIA 2013.

15 Burke 2012.

16 McCormick University 2012. See also Chen 2013.

17 Sims 2011.

18 See www.flightcaster.com.

19 United Nations 2012.

20 Tapscott and Williams 2007.

21 Pélissié du Rausas et al. 2011.

22 Mandel 2012, p. 1.

23 A collection of studies that quantify the contribution of the Internet to GDP is available at www.valueoftheweb.com.

24 The Economist 2013b.

25 The Economist 2011.

26 Dugas et al. 2013.

27 Lu et al. 2012.

28 Talbot 2013.

29 Brynjolfsson et al. 2011.

30 Cacciola and Gibbons 2012.

31 Manyika et al. 2011.

32 Esty and Rushing 2007.

33 Rojas 2012.

34 Esty and Rushing 2007.

35 Manyika et al. 2011.

36 Hemerly 2013.

37 For example, an IP address, by itself, cannot be linked to nor identify an individual, because it identifies only a device connected to a network.

38 Manyika et al. 2011.

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CHAPTER 1.9

Making Big Data Something More than the "Next Big Thing"

ANANT GUPTA
HCL Technologies

Big data is the business buzzword du jour. But how can you turn this hot topic into a real source of business value?

You have certainly heard the breathless spiel: The world today is being flooded with digital data, in myriad manifestations and washing over us at such incredible speed that making sense of it is dauntingly difficult. Yet this tidal wave of data—when channeled and filtered by an array of new information technologies—holds untold value for organizations, whether they are small not-for-profits or Fortune 500 companies.

Or so we are told. But despite the sometimes exaggerated hype surrounding "big data," the fundamental assertion is true: data—and the decisions driven by those data—now represent the next frontier of innovation and productivity.

Estimates of the potential benefits of leveraging big data are indeed staggering: productivity-led savings worth US$300 billion a year for the US healthcare industry and €250 billion for the European public sector, a 60 percent potential increase in retailers' operating margins.[1] And technology seems poised to deliver these benefits. One small example: data storage technology has advanced to the point that only US$600 is all it takes to purchase storage space that can accommodate the entire world's music![2]

Some large companies have indeed used emerging technologies to extract significant value from big data. Visa recently announced that increasing from 40 to 200 the number of attributes it analyzes in each credit card transaction has saved 6 cents in every $100 worth of transactions.[3] Wal-Mart uses a self-teaching semantic search tool that, honed by the monthly clickstream data of 45 million online shoppers, tailors offerings to online shoppers, raising the rate of completed transactions by more than 10 percent.[4]

But for most businesses, the promise of big data is nowhere close to being fulfilled. For one thing, spending on it is polarized. While the telecommunications, travel, retail, life sciences, and financial services industries are making significant strides in big data technologies, other industries, such as manufacturing and government,[5] are in a wait-and-watch mode.

The lack of major big data initiatives across industries can be seen in the numbers from service providers. In 2012, the global top 20 big data players made *less than 1 percent* of their total revenues from big data. The total market for big data hardware, software, and services in 2012 was US$11.5 billion, whereas the combined overall revenue of those 20 big data players was more than US$1.2 trillion.

The disparity between a few success stories and the lack of action elsewhere has created a high level of anxiety within firms that have not yet begun to explore big data. But it is important that they not rush thoughtlessly into the fray. An organization should make

Box 1: A user's glossary of key big data terms

As an organization plans its big data strategy, the following terms are likely to be used with increasing frequency.

- **Hadoop:** A batch-oriented programming framework that supports the processing of large data sets in a distributed computing environment. Hadoop is written in the Java programming language and is a top-level Apache project (Apache is a decentralized community of developers supporting open-source software).
- **HBase:** A non-relational, column-oriented distributed database written in Java. A column-oriented database stores data tables as sections of columns of data rather than as rows of data, as in most relational databases, providing fast aggregation and computation of large numbers of similar data items.
- **HDFS:** A distributed, scalable, and portable file system written in Java for the Hadoop framework.
- **Hive:** A data warehouse infrastructure built on top of Hadoop, providing data summarization, query, and analysis. It permits queries over the data using a familiar SQL-like syntax.
- **Flume:** A tool for collecting, aggregating, and moving large amounts of log data from applications to Hadoop.
- **Mahout**: A library of Hadoop implementations of common analytical computations.
- **Oozie:** A workflow scheduler system developed to manage Hadoop jobs.
- **Pig:** A platform for analyzing large datasets that consists of a high-level language (Pig Latin) for expressing data analysis programs, coupled with infrastructure for evaluating these programs.
- **R:** R is a free software programming language and software environment for statistical computing and graphics. The R language is widely used among statisticians and data miners for developing statistical software and data analysis.
- **Sqoop:** A tool facilitating the transfer of data from relational databases into Hadoop.
- **Zookeeper:** A centralized service for maintaining configuration information, naming, providing distributed synchronization, and providing group services for distributed applications.

Source: HCL 2013b.

a big data investment only if it has well-defined and realizable business objectives.

We offer here nine steps that companies can take to begin turning big data talk into action, buzz into business benefits.

WHY IS EXTRACTING VALUE FROM BIG DATA SO HARD?

First, though, we examine some of the barriers to realizing big data's promise.

Volume, velocity, and variety

Big data is often said to be characterized by 3 Vs: its tremendous volume, the velocity at which it needs to be processed, and the variety of data types it encompasses. The first two characteristics are fairly obvious: technology has made it possible to capture increasingly large amounts of information and make it available for analysis in real time.

But mining the value of big data also is difficult because it requires simultaneously analyzing various types of information—transactions, log data, mail documents, social media interactions, machine data, geospatial data, video and audio data, to name just a few—much of which is "unstructured." Traditional types of business data were available in a format that was structured and could have been automatically analyzed—for example, a spreadsheet quantifying customer returns of different products at different stores over time. However, much of the value in big data exists in unstructured information—for example, the transcript of a chat session between a retail customer and a customer service representative.

Synthesizing unstructured data from numerous sources and extracting relevant information from it can be as much art as science.

Talent scarcity

Much has been said and published about the looming talent gap. Estimates suggest that the United States alone faces a shortage of 140,000 to 190,000 people with deep analytical skills, as well as 1.5 million analysts and managers to analyze big data and make decisions based on those findings.[6] Another report predicts that only one-third of 4.4 million big data jobs created by 2015 will be filled.[7] Unlike traditional analytics, mining big data requires an extremely diverse set of skills—deep business insights, data visualization, statistics, machine learning, and computer programming. Policy should work to mitigate this talent shortage through forward-looking education and immigration policies.

Flawed data governance

Big data is not a substitute for—much less a solution for—flawed information management practices. If anything, it requires much more rigorous data governance structures. Without those improvements, information technology (IT) systems that have not been upgraded to handle large volumes of data are likely to collapse under the sheer weight of the data being processed. Surveys suggest that business leaders are often more excited about the potential of big data

than their IT counterparts. That may be because of IT executives' understanding of the realities on the ground.

Lack of a data-driven mind-set

Because mind-set can be hard to pin down, its power is often underestimated. That is a mistake when it comes to assessing the prerequisites to successful analytics deployment. It is virtually impossible for big data investments to deliver value if business leaders do not have a data-driven mind-set—that is, if they do not believe that it is important for decisions to be based on cold, hard numbers rather than gut feel and experience. But once the right mind-set takes hold, other good things will follow: data-driven business leaders will have a tremendous incentive to treat data, and therefore the IT and analytics professionals who help deliver it in an understandable form, as a strategic asset. And these leaders will make it a priority to ease the flow of data across organizational silos.

Lack of technical know-how

Big data represents a convergence of IT and data science. Technologies include Hadoop (which enables large-scale processing of diverse datasets), R (a programming language for statistics), and in-memory databases (where data reside on main memory as opposed to disk storage). Data science includes, among many other areas, machine learning (systems that learn from data) and data warehousing. Big data professionals are expected to be familiar with both disciplines, but this combination is rare, despite the training courses that are sprouting up globally. (For descriptions of some of the technologies that enable the analysis of big data, see Box 1.)

NINE STEPS TO BIG DATA VALUE CREATION

The barriers to extracting business value from big data can seem daunting. But they can be overcome through a systematic plan, one that breaks down the challenge into a series of nine sequential steps that will enable organizations to take advantage of this valuable and growing asset. We will consider each of these steps individually here.

Step 1: Define responsibilities.

Who collects, who analyzes, and who drives value? The onus of collecting data should be shared by the IT and analytics teams, but analysis must be the sole responsibility of analytics professionals. Similarly, only functional leaders—for example, the Chief Marketing Officer, the Chief Financial Officer, and the Chief Procurement Officer—should be responsible for identifying areas within their respective functions where big data could drive value. However, getting this level of support from functional leaders is not easy, especially if the team—IT and analytics or a dedicated big data center of excellence—reside outside of the business function. In order to drive the big data program, the team may want to appoint a big data program sponsor for each function and work closely with him or her to discover and locate the types of information that would improve business outcomes. Most importantly, however, the program sponsor would try to get functional buy-in and identify big data opportunities within the function.

Step 2: Get the business functions to ask the right questions.

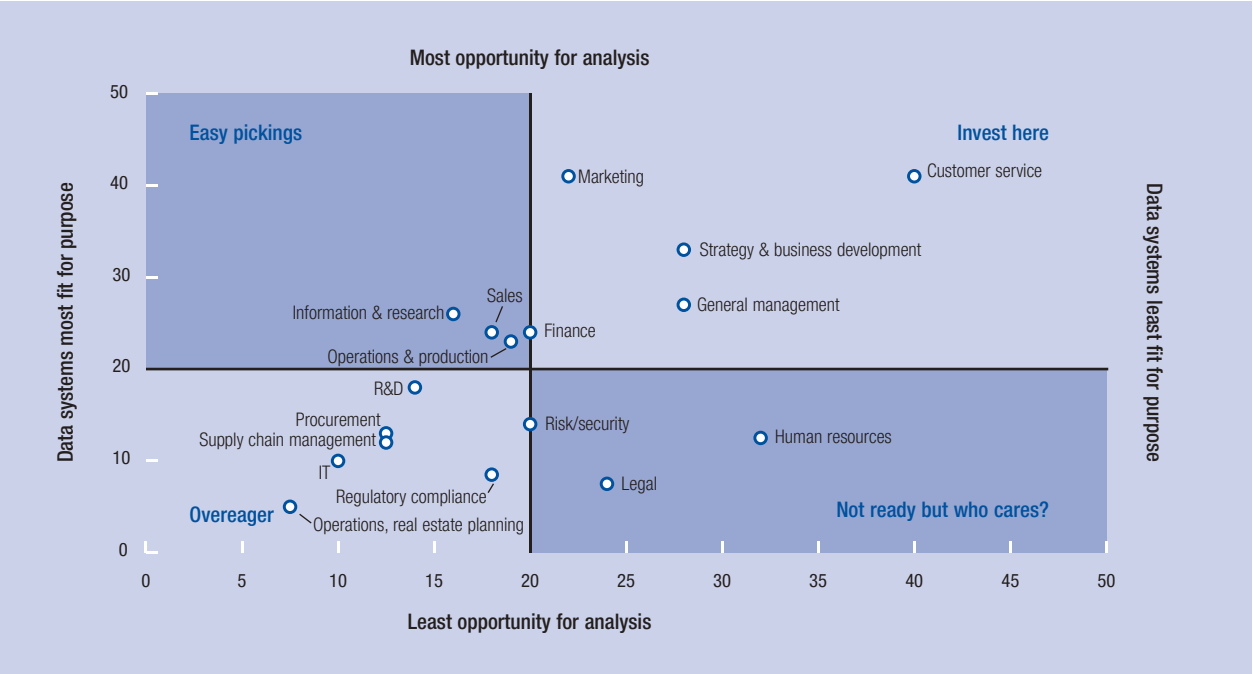
Senior executives will have an easier time winning buy-in from business functions if they demonstrate how big data might be valuable to them. Simple questions such as "What would you really like to know about your business, and how can data help you with it?" are a good place to start. Such questions can spur the functional experts themselves to start asking the more fundamental questions that can unlock the value of data. For instance, marketing professionals could ask, "What is the value of a 'tweet' or a 'like'? Are our investments in customer service paying off? What is the optimal price for our product right now?" The ability to ask the right questions is key to succeeding with big data. It also pays to keep in mind that big data is *not* about data themselves; it is about using data to discover insights that can lead to valuable outcomes.

Step 3: Take stock of all data "worth analyzing."

Valuable business insight can come from many sources, including social media feeds, activity streams, and "dark data" (data that are currently unused but that have already been captured), machine instrumentation, and operational technology feeds. It is important to explore these sources and to experiment with new ways of capturing information, such as complex-event processing, video search, and text analytics. Organizations' data typically fit into four buckets:

- Operational data, such as data emanating from smart grid meters, embedded systems (examples include microwave sensors and chips inserted in automobiles), transactions logs (such as payment transactions), radio-frequency identification chips (RFID), navigation and location sensors, networks, and servers.
- Streaming data, such as computer network data, phone conversations, and so on.
- Documents and content, such as PDFs, web content, and legal discovery elements (electronic information exchange in civil litigations).
- Rich media, including audio and video tracks, electronic images, and so on.

Figure 1: Potential payback of big data initiatives



Source: Gartner, 2013.

Step 4: Select the business functions best positioned to lead the way.

It is smart to launch big data initiatives in business functions that are most ready to collect and analyze data and for which the potential payback is high. Functions such as marketing, customer service, supply chain management, and finance are poised for maximum growth. If system readiness is not an issue, these are usually the right places to direct initial investments (see Figure 1).

Step 5: Match big data initiatives with compatible business functions.

Some big data programs can be implemented in a variety of settings, but most are suited to specific functions. For example:

- Customer functions (such as marketing, e-commerce, and customer service) can use big data for targeted advertising that provides personalized offers to consumers based on their socio-demographic characteristics, and for loyalty management that extends channel reach from point of sale, web, and call center to include mobile and social capabilities.
- Finance functions (such as finance, risk, and treasury) can use big data for intraday liquidity management, providing real-time monitoring of price movements in relation to positions, to make trading and rebalancing decisions, and for improved credit risk assessment, through multiple big data–supported credit risk assessments that factor in hundreds or even thousands of indicators.
- Supply chain and procurement can use big data for dynamic route optimization because big data technologies that are faster than conventional systems allow more iterations and faster route planning in real-time.

Step 6: Determine whether big data will yield valuable information unavailable through traditional business analytics.

Making the business case for a big data initiative clearly will be easier if it can be shown that it creates new value. For instance, if a marketing department is currently segmenting customer profiles using standard demographic indicators, would there be additional benefit in analyzing attitudes and preferences (at a granular level) through text and speech analysis? Similarly, if a traditional business intelligence program is currently analyzing financial market sentiments using structured stock information, would it make the sentiment analysis more refined by including social media feeds, news sites, and so on?

In comparing views of data from a traditional business intelligence perspective versus a big data one, consider the following the questions: What data are we capturing today? What are the limitations of this kind of structured data? What extra value will we get by collecting external, context-specific, and unstructured data? Where will we find data and how will we collect them? Would our business act upon the insights

gained? Is the extra business value worth the additional investment of time, energy, and money?

Step 7: Assess complexities and prioritize accordingly.

All else being equal, an organization should begin its big data experimentation with an initiative that is not too demanding. In assessing possibilities, it is helpful to keep in mind the complexity of both the *type of data* and the *type of analysis* the data will require.

As we mentioned above, much of what is meant by "big data" is unstructured information—data that traditionally have been impossible to break down and categorize as they are collected. Such data are not only difficult to analyze but can also be easily misinterpreted when taken out of context. Thus it makes sense to experiment in the beginning with data that are relatively easy to analyze.

Different types of analysis also present varying degrees of complexity. Generally speaking, descriptive analytics (which answers "what happened?"—for example, an analysis of social media sentiment analysis) are relatively easy to do. However, diagnostic analytics (which answers "why did it happen?"—for example, an analysis of customer defection at the shopping cart stage of the online purchase process); predictive analytics (which answers "what will happen?"—for example, forecasts of customer churn in telecommunications); and prescriptive analytics (which answers "how can we make it happen?"—for example, determining whether personalized offers to customers would make sense), are increasingly complex to conduct.

Step 8: Assess your technology architecture.

An organization's traditional information architecture may not accommodate massive, high-speed, variable data flows. Many traditional and even state-of-the-art technologies were not designed for today's or tomorrow's level of data volume, velocity, and variety. Even as datasets grow exponentially along those dimensions, the investments required for scaling technologies (such as processors, storage, database management systems, and analytics) to perform efficiently grow even faster. To counter these intractable economics, organizations need to consider a variety of methods to upgrade their infrastructure in support of or in anticipation of big data.

In fact, the idea that big data involves negligible cost because it is analyzed using open-source tools and platforms is a myth. "Free" open-source technologies such as Hadoop (which enables large-scale processing of diverse datasets) are typically not immediately usable. You need either to hire and train data scientists and analysts in Hadoop programming, or to buy an enterprise-ready version of Hadoop.

If the outcome of big data analysis is mission-critical for your business, it probably makes sense to use only purpose-built hardware. Generic servers may be fine for smaller projects and proofs of concept, but specifically designed, enterprise-grade servers, storage, and networking products are best for large-scale-production solutions.

Creating or upgrading to big data–ready technology architecture is no small feat. Building everything from scratch takes time, and buying everything is expensive. Therefore, finding the right combination of insourcing and outsourcing requires careful consideration.

Step 9: Start building a team.

Big data initiatives require multidisciplinary teams of business and technology experts. Every team member—business analyst, programmer, data scientist, and data visualizer—will need to have cross-functional familiarity. Building this team is a five-step process:

- Break down your talent needs into four distinct areas: business analysis, analytics, database technology, and data visualization.
- Scan your internal landscape for the aforementioned skills. Although they may not be in the target department, every organization probably already includes people who know the business, possess data-crunching capabilities, and make data-driven decisions.
- Hire people with needed skills if they are not available or cannot be acquired by cross-training existing employees.
- Hire people with related skills if the needed skills are unavailable within your organization or difficult to acquire through external hires. For instance, consider substituting statisticians for the much less common data scientists.
- Start small and scale up. In the beginning, your needs will be modest. A few hires may be adequate to get started.

Some are even predicting that big data analytics will lead to the emergence of an entirely new set of CXO roles within enterprises—Chief Data Officer, Chief Digital Officer, Chief Analytics Officer, and so on. That said, the structure of most organizations would make it difficult for someone owning the big data portfolio to succeed. Without clear line responsibilities, a CDO (whichever flavor, Data or Digital) or a CAO would have little leverage to execute the important tasks needed to increase the organization's big data capabilities and optimize its initiatives.

Instead, big data and business analytics expertise should fall within existing functions—for example, finance, human resources, and marketing—with the aim of furthering the strategic initiatives of those functions. The efforts of the big data teams in these areas could be overseen and coordinated by a big data manager, reporting to the Chief Information Officer, who would

Box 2: Organizations already using big data initiatives

A few organizations that have followed frameworks for using big data include:

- A US-based mid- to upscale chain of department stores is gaining new insights from analyzing and combining data on Hadoop with data from traditional databases to turn its marketing staff from "Mad Men" to "Math Men."
- A US-based provider of business outsourcing solutions has set up an innovation lab where subject experts from different industries and backgrounds work together to tackle big data analytics.
- An Indianapolis-based global pharmaceutical company is using big data to develop an integrated approach to optimizing how clinical trials are conducted and eliminate inefficiencies.
- A US-based document management corporation is applying its decades of expertise in imaging technologies to transportation systems that can benefit from real-time analysis of data.
- Australia-based telecommunications companies use big data to determine which of their customers are less likely to pay their bills, allowing them to focus collection efforts on that group rather than across the whole customer base.
- A global corporation offering computer-assisted legal research services uses a big data technology platform it has developed in house both for its risk management business and for gathering data it sells to its clients. It now also sells this big data platform through its newly established subsidiary.
- A US-based multinational consumer goods company has developed a decision-support environment used by more than 60,000 employees worldwide to see what is happening in the business, to understand why it is happening, and to determine how to respond to changing market conditions. The decision cockpit is focused on forward-looking projections rather than historical reporting, with data visualization showing the relative revenue and profit contribution of each region, country, territory, brand, and product. The company's performance is also tracked against that of competing brands and products. The company has established about 50 collaborative conference rooms, called Business Spheres, in offices around the globe. The rooms are surrounded by projection screens for displaying the dashboards as well as live video-conferencing sessions, allowing remote executives to attend weekly review meetings in person.
- A California-based multinational energy corporation is using big data to transform the audit function. It runs audit tests on all of its accounts payable transactions instead of only on the small sample it used to analyze before. This enables the finance department to better understand various business risks and adjust audit coverage to the areas that pose the greatest risks. At the same time, it reduces the time spent on auditing by about 15 percent.
- A British multinational music recording and publishing company has created the Million Interview Dataset over the last few years, asking consumers in 24 countries and across 15 languages about their music listening and consumption habits. The Dataset provides rich insights into the interests, attitudes, behaviors, familiarity, and appreciation of music as expressed by music fans.
- A Minnesota-based member-owned agricultural cooperative combines 20 years of satellite imagery with local seed and crop protection data from its test sites to provide a service that generates field performance information for every acre and matches crop inputs and decisions to the potential of each field and each zone.

Source: HCL Technologies.

ensure that best practices were adopted and that initiatives were coordinated.

Following the nine steps described above will help the IT function to assume such responsibilities.

CASE STUDIES

Many global organizations have already begun embarking on deriving value out of big data initiatives. Almost all of them have defined step-by-step frameworks somewhat similar to the one outlined above. The sheer variety of value creation evident—from clinical trials and marketing to risk management and audits, from analyzing crop and seed production to fan listening posts—is also staggering (see Box 2).

RECOMMENDATIONS FOR GOVERNMENT ACTIONS AND POLICIES

In order to take full advantage of the potential of big data in both the public and private sectors, we recommend that governments create a vision and platform for public-sector open data. We believe that open data will be an *essential characteristic of future public policy.* It is important that such a vision percolate down from the top to garner support from ministries and civil servants alike so that open data initiatives function effectively.

Communicating from the very top that open data is an essential characteristic of public policy is crucial. Furthermore, governments should create an easy-to-use platform for the public to access the data in a form that is easily digestible and ready for analysis. It is also advisable to develop rules and regulations for taxing the commercial use of open data.

Governments should spearhead the effort to ensure the privacy and security of personal data. The appropriate agency should take a leading role in working with all relevant private- and public-sector entities to develop and implement policies for safeguarding personal data and means for enforcement.

Moreover, it is essential to develop and execute a big data plan for all government services and activities. The plan should identify all government data worth analyzing, define data collection responsibilities, outline steps to ensure data quality, and determine where big data technologies and analysis capabilities should be first deployed.

Finally, each government should establish a big data center of excellence (BDCOE). The BDCOE should be the focal point of expertise, long-range thinking and policy formulation, and training and development. It should also be the repository of best practices. It should not only serve as a resource for all government agencies but should also act as the government's leading authority on all matters related to data management.

CONCLUSION

Big data analytics is not a passing fad. It will be a central means of creating value for the organization of tomorrow—and that is "tomorrow" almost literally. It represents a major change in the way that businesses and other organizations will operate and will require a new mind-set and new capabilities. Given that, many organizations are struggling to know where to start in becoming competent in the realm of big data. A step-by-step approach can make the transition seem less daunting and minimize the stumbles that are bound to occur along the way.

NOTES

1 Manyika et al. 2011.

2 Manyika et al. 2011.

3 Laney 2012.

4 Laney 2012.

5 HCL Technologies 2013a.

6 Manyika et al. 2011.

7 Manyika et al. 2011.

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Part 2

Country/Economy Profiles

How to Read the Country/Economy Profiles

The Country/Economy Profiles section presents a profile for each of the 148 economies covered in *The Global Information Technology Report 2014.* Each profile summarizes an economy's performance in the various dimensions of the Networked Readiness Index (NRI).

1 PERFORMANCE HIGHLIGHTS

The first section of the profile presents the economy's overall performance in the NRI, along with its performance in the NRI's four components and 10 pillars. The economy's rank (out of 148 economies) and score (on a 1-to-7 scale) are reported.

2 On the radar chart to the right of the table, a blue line plots the economy's score on each of the 10 pillars. The black line represents the average score of all economies in the income group to which the economy under review belongs. The country classification by income group is defined by the World Bank and reflects the situation as of December 2013. Note that the two high-income groups in this classification, *High income: OECD* and *High income: non-OECD*, were merged into a single group for the purpose of the analysis.

3 THE NETWORKED READINESS INDEX IN DETAIL

This section presents an economy's performance in each of the 54 indicators composing the NRI. The indicators are organized by pillar. The numbering of the variables matches that of the data tables in the next section of the *Report*, which provide descriptions, rankings, and scores for all the indicators. The indicators derived from the 2012 and 2013 editions of the World Economic Forum's Executive Opinion Survey are identified by an asterisk (*). These indicators are always measured on a 1-to-7 scale (where 1 and 7 correspond to the worst and best possible outcomes, respectively). For more information on the Executive Opinion Survey and a detailed explanation of how scores are computed, please refer to Chapter 1.3 of *The Global Competitiveness Report 2013–2014*, available for free on the World Economic Forum website at www.weforum.org/gcr.

For those indicators not derived from the World Economic Forum's Executive Opinion Survey, the scale is reported next to the title. The Technical Notes and Sources at the end of this *Report* provides further details on each indicator, including its definition, method of computation, and sources.

Note that for the sake of readability, the years were omitted. However, the year of each data point is indicated in the corresponding data table. For more information on the framework and computation of the NRI, refer to Chapter 1.1.

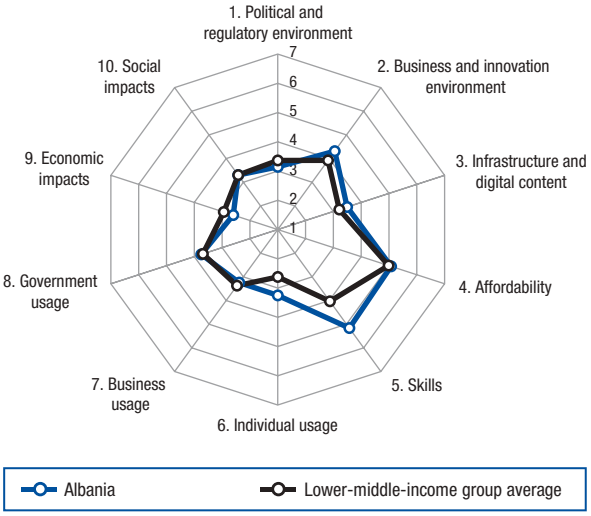
ONLINE DATA PORTAL

In complement to the analysis presented in this *Report*, an online data portal can be accessed via www.weforum.org/gitr. The platform offers a number of analytical tools and visualizations, including sortable rankings, scatter plots, bar charts, and maps, as well as the possibility of downloading portions of the NRI dataset.

Index of Country/Economy Profiles

Albania

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**95**	**3.7**
Networked Readiness Index 2013 (out of 144)	83	3.8
A. Environment subindex	**95**	**3.7**
1st pillar: Political and regulatory environment	117	3.1
2nd pillar: Business and innovation environment	65	4.3
B. Readiness subindex	**86**	**4.6**
3rd pillar: Infrastructure and digital content	90	3.5
4th pillar: Affordability	87	5.1
5th pillar: Skills	62	5.2
C. Usage subindex	**95**	**3.4**
6th pillar: Individual usage	82	3.2
7th pillar: Business usage	107	3.2
8th pillar: Government usage	93	3.8
D. Impact subindex	**108**	**2.9**
9th pillar: Economic impacts	125	2.6
10th pillar: Social impacts	97	3.3



The Networked Readiness Index in detail

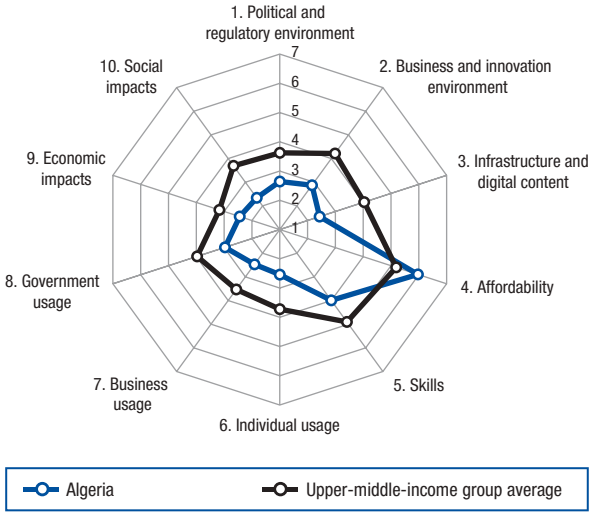
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	105	3.1
1.02	Laws relating to ICTs*	85	3.7
1.03	Judicial independence*	134	2.3
1.04	Efficiency of legal system in settling disputes*	120	3.0
1.05	Efficiency of legal system in challenging regs*	113	2.9
1.06	Intellectual property protection*	114	2.9
1.07	Software piracy rate, % software installed	77	75
1.08	No. procedures to enforce a contract	91	39
1.09	No. days to enforce a contract	69	525
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	119	4.1
2.02	Venture capital availability*	136	1.9
2.03	Total tax rate, % profits	48	31.7
2.04	No. days to start a business	12	5
2.05	No. procedures to start a business	34	5
2.06	Intensity of local competition*	144	3.4
2.07	Tertiary education gross enrollment rate, %	50	54.9
2.08	Quality of management schools*	84	4.1
2.09	Gov't procurement of advanced tech*	52	3.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	93	1318.7
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	76	17.4
3.04	Secure Internet servers/million pop.	85	19.0
3.05	Accessibility of digital content*	116	4.1
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	120	0.44
4.02	Fixed broadband Internet tariffs, PPP $/month	48	26.05
4.03	Internet & telephony competition, 0–2 (best)	92	1.64
	5th pillar: Skills		
5.01	Quality of educational system*	52	4.0
5.02	Quality of math & science education*	54	4.3
5.03	Secondary education gross enrollment rate, %	90	82.4
5.04	Adult literacy rate, %	56	96.8

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	70	110.7
6.02	Individuals using Internet, %	58	54.7
6.03	Households w/ personal computer, %	95	20.0
6.04	Households w/ Internet access, %	87	20.5
6.05	Fixed broadband Internet subs./100 pop.	78	5.1
6.06	Mobile broadband subscriptions/100 pop.	71	18.8
6.07	Use of virtual social networks*	110	5.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	108	4.2
7.02	Capacity for innovation*	121	3.0
7.03	PCT patents, applications/million pop.	85	0.3
7.04	Business-to-business Internet use*	135	3.8
7.05	Business-to-consumer Internet use*	131	3.4
7.06	Extent of staff training*	36	4.4
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	78	3.9
8.02	Government Online Service Index, 0–1 (best)	88	0.42
8.03	Gov't success in ICT promotion*	106	3.9
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	121	3.6
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	124	3.4
9.04	Knowledge-intensive jobs, % workforce	99	13.7
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	126	3.3
10.02	Internet access in schools*	73	4.2
10.03	ICT use & gov't efficiency*	82	4.0
10.04	E-Participation Index, 0–1 (best)	92	0.11

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Algeria

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**129**	**3.0**
Networked Readiness Index 2013 (out of 144)	131	2.8
A. Environment subindex	**143**	**2.8**
1st pillar: Political and regulatory environment	140	2.6
2nd pillar: Business and innovation environment	145	2.9
B. Readiness subindex	**101**	**4.1**
3rd pillar: Infrastructure and digital content	127	2.4
4th pillar: Affordability	42	6.0
5th pillar: Skills	102	4.0
C. Usage subindex	**134**	**2.7**
6th pillar: Individual usage	104	2.5
7th pillar: Business usage	147	2.5
8th pillar: Government usage	134	3.0
D. Impact subindex	**137**	**2.4**
9th pillar: Economic impacts	133	2.4
10th pillar: Social impacts	140	2.3



The Networked Readiness Index in detail

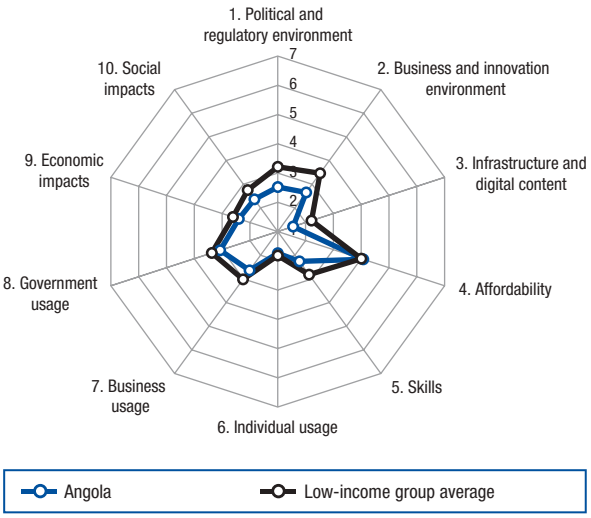
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	125	2.7
1.02	Laws relating to ICTs*	146	2.1
1.03	Judicial independence*	95	3.2
1.04	Efficiency of legal system in settling disputes*	116	3.1
1.05	Efficiency of legal system in challenging regs*	139	2.3
1.06	Intellectual property protection*	145	2.2
1.07	Software piracy rate, % software installed	95	84
1.08	No. procedures to enforce a contract	131	45
1.09	No. days to enforce a contract	101	630
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	144	3.2
2.02	Venture capital availability*	123	2.0
2.03	Total tax rate, % profits	142	71.9
2.04	No. days to start a business	103	25
2.05	No. procedures to start a business	142	14
2.06	Intensity of local competition*	141	3.6
2.07	Tertiary education gross enrollment rate, %	78	31.5
2.08	Quality of management schools*	135	3.0
2.09	Gov't procurement of advanced tech*	127	2.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	90	1356.5
3.02	Mobile network coverage, % pop.	124	81.5
3.03	Int'l Internet bandwidth, kb/s per user	99	7.7
3.04	Secure Internet servers/million pop.	128	1.3
3.05	Accessibility of digital content*	144	3.0
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	49	0.18
4.02	Fixed broadband Internet tariffs, PPP $/month	28	20.94
4.03	Internet & telephony competition, 0–2 (best)	104	1.33
	5th pillar: Skills		
5.01	Quality of educational system*	133	2.7
5.02	Quality of math & science education*	132	2.7
5.03	Secondary education gross enrollment rate, %	46	97.6
5.04	Adult literacy rate, %	117	72.6

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	94	97.9
6.02	Individuals using Internet, %	113	15.2
6.03	Households w/ personal computer, %	90	24.2
6.04	Households w/ Internet access, %	91	19.4
6.05	Fixed broadband Internet subs./100 pop.	90	2.9
6.06	Mobile broadband subscriptions/100 pop.	140	0.0
6.07	Use of virtual social networks*	104	5.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	147	3.2
7.02	Capacity for innovation*	147	2.3
7.03	PCT patents, applications/million pop.	98	0.1
7.04	Business-to-business Internet use*	147	3.0
7.05	Business-to-consumer Internet use*	145	2.7
7.06	Extent of staff training*	139	3.0
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	122	3.2
8.02	Government Online Service Index, 0–1 (best)	123	0.25
8.03	Gov't success in ICT promotion*	136	3.2
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	145	2.9
9.02	ICT PCT patents, applications/million pop.	83	0.0
9.03	Impact of ICTs on new organizational models*	140	2.9
9.04	Knowledge-intensive jobs, % workforce	80	19.1
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	138	3.0
10.02	Internet access in schools*	138	2.2
10.03	ICT use & gov't efficiency*	141	2.9
10.04	E-Participation Index, 0–1 (best)	107	0.05

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Angola

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**144**	**2.5**
Networked Readiness Index 2013 (out of 144)	n/a	n/a
A. Environment subindex	**147**	**2.6**
1st pillar: Political and regulatory environment	145	2.5
2nd pillar: Business and innovation environment	147	2.7
B. Readiness subindex	**138**	**2.6**
3rd pillar: Infrastructure and digital content	146	1.6
4th pillar: Affordability	110	4.1
5th pillar: Skills	141	2.3
C. Usage subindex	**142**	**2.5**
6th pillar: Individual usage	133	1.7
7th pillar: Business usage	143	2.6
8th pillar: Government usage	131	3.1
D. Impact subindex	**138**	**2.4**
9th pillar: Economic impacts	137	2.4
10th pillar: Social impacts	139	2.4



The Networked Readiness Index in detail

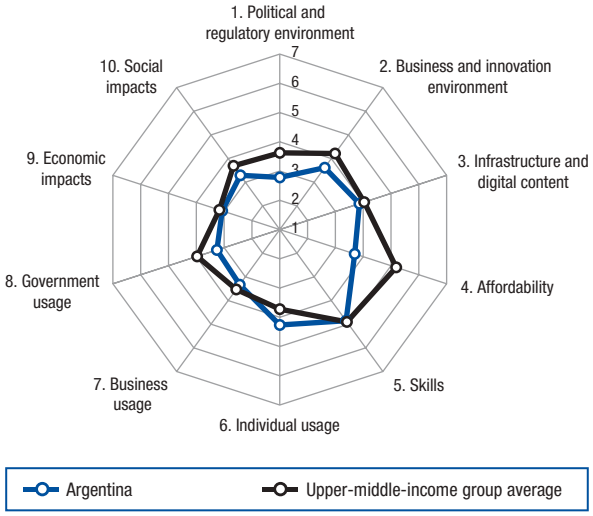
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	97	3.2
1.02	Laws relating to ICTs*	143	2.3
1.03	Judicial independence*	127	2.4
1.04	Efficiency of legal system in settling disputes*	129	2.7
1.05	Efficiency of legal system in challenging regs*	144	2.2
1.06	Intellectual property protection*	137	2.4
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	134	46
1.09	No. days to enforce a contract	140	1296
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	139	3.5
2.02	Venture capital availability*	119	2.1
2.03	Total tax rate, % profits	124	52.1
2.04	No. days to start a business	137	66
2.05	No. procedures to start a business	94	8
2.06	Intensity of local competition*	148	2.8
2.07	Tertiary education gross enrollment rate, %	128	7.5
2.08	Quality of management schools*	148	2.2
2.09	Gov't procurement of advanced tech*	133	2.6
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	120	280.0
3.02	Mobile network coverage, % pop.	139	40.0
3.03	Int'l Internet bandwidth, kb/s per user	142	0.6
3.04	Secure Internet servers/million pop.	110	3.5
3.05	Accessibility of digital content*	135	3.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	81	0.28
4.02	Fixed broadband Internet tariffs, PPP $/month	115	57.22
4.03	Internet & telephony competition, 0–2 (best)	104	1.33
	5th pillar: Skills		
5.01	Quality of educational system*	144	2.2
5.02	Quality of math & science education*	147	2.1
5.03	Secondary education gross enrollment rate, %	140	31.5
5.04	Adult literacy rate, %	121	70.4

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	138	47.1
6.02	Individuals using Internet, %	109	16.9
6.03	Households w/ personal computer, %	118	8.5
6.04	Households w/ Internet access, %	115	7.2
6.05	Fixed broadband Internet subs./100 pop.	124	0.2
6.06	Mobile broadband subscriptions/100 pop.	120	1.5
6.07	Use of virtual social networks*	123	4.8
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	145	3.3
7.02	Capacity for innovation*	146	2.5
7.03	PCT patents, applications/million pop.	118	0.0
7.04	Business-to-business Internet use*	144	3.2
7.05	Business-to-consumer Internet use*	139	3.0
7.06	Extent of staff training*	124	3.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	137	2.8
8.02	Government Online Service Index, 0–1 (best)	106	0.33
8.03	Gov't success in ICT promotion*	126	3.4
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	137	3.3
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	137	2.9
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	144	2.7
10.02	Internet access in schools*	127	2.6
10.03	ICT use & gov't efficiency*	138	2.9
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Argentina

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**100**	**3.5**
Networked Readiness Index 2013 (out of 144)	99	3.5
A. Environment subindex	**135**	**3.2**
1st pillar: Political and regulatory environment	135	2.8
2nd pillar: Business and innovation environment	122	3.6
B. Readiness subindex	**100**	**4.1**
3rd pillar: Infrastructure and digital content	78	3.9
4th pillar: Affordability	121	3.7
5th pillar: Skills	79	4.9
C. Usage subindex	**77**	**3.6**
6th pillar: Individual usage	57	4.3
7th pillar: Business usage	99	3.3
8th pillar: Government usage	121	3.3
D. Impact subindex	**96**	**3.2**
9th pillar: Economic impacts	87	3.1
10th pillar: Social impacts	98	3.3



The Networked Readiness Index in detail

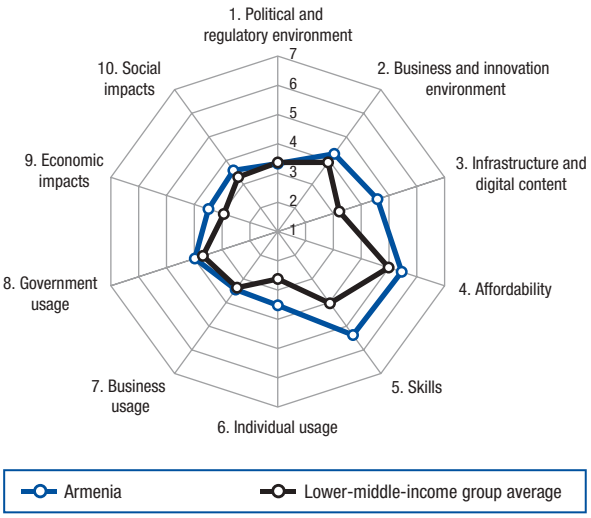
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	146	2.1
1.02	Laws relating to ICTs*	127	2.9
1.03	Judicial independence*	132	2.4
1.04	Efficiency of legal system in settling disputes*	133	2.6
1.05	Efficiency of legal system in challenging regs*	147	1.9
1.06	Intellectual property protection*	139	2.3
1.07	Software piracy rate, % software installed	69	69
1.08	No. procedures to enforce a contract	55	36
1.09	No. days to enforce a contract	87	590
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	123	4.0
2.02	Venture capital availability*	142	1.7
2.03	Total tax rate, % profits	147	107.8
2.04	No. days to start a business	103	25
2.05	No. procedures to start a business	142	14
2.06	Intensity of local competition*	134	4.0
2.07	Tertiary education gross enrollment rate, %	17	74.8
2.08	Quality of management schools*	33	4.9
2.09	Gov't procurement of advanced tech*	140	2.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	65	3180.9
3.02	Mobile network coverage, % pop.	109	94.1
3.03	Int'l Internet bandwidth, kb/s per user	67	22.0
3.04	Secure Internet servers/million pop.	62	41.8
3.05	Accessibility of digital content*	88	4.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	141	0.77
4.02	Fixed broadband Internet tariffs, PPP $/month	79	33.99
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	104	3.2
5.02	Quality of math & science education*	116	3.2
5.03	Secondary education gross enrollment rate, %	72	90.2
5.04	Adult literacy rate, %	50	97.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	19	151.9
6.02	Individuals using Internet, %	54	55.8
6.03	Households w/ personal computer, %	58	56.0
6.04	Households w/ Internet access, %	58	47.5
6.05	Fixed broadband Internet subs./100 pop.	56	10.9
6.06	Mobile broadband subscriptions/100 pop.	69	20.9
6.07	Use of virtual social networks*	45	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	115	4.1
7.02	Capacity for innovation*	91	3.3
7.03	PCT patents, applications/million pop.	62	1.3
7.04	Business-to-business Internet use*	106	4.4
7.05	Business-to-consumer Internet use*	68	4.6
7.06	Extent of staff training*	100	3.7
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	143	2.5
8.02	Government Online Service Index, 0–1 (best)	59	0.53
8.03	Gov't success in ICT promotion*	141	3.1
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	116	3.7
9.02	ICT PCT patents, applications/million pop.	61	0.3
9.03	Impact of ICTs on new organizational models*	88	3.9
9.04	Knowledge-intensive jobs, % workforce	56	25.0
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	118	3.5
10.02	Internet access in schools*	79	4.0
10.03	ICT use & gov't efficiency*	140	2.9
10.04	E-Participation Index, 0–1 (best)	52	0.29

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Armenia

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**65**	**4.0**
Networked Readiness Index 2013 (out of 144)	82	3.8
A. Environment subindex	**83**	**3.8**
1st pillar: Political and regulatory environment	104	3.3
2nd pillar: Business and innovation environment	67	4.3
B. Readiness subindex	**51**	**5.1**
3rd pillar: Infrastructure and digital content	53	4.6
4th pillar: Affordability	63	5.4
5th pillar: Skills	47	5.4
C. Usage subindex	**73**	**3.7**
6th pillar: Individual usage	74	3.5
7th pillar: Business usage	82	3.5
8th pillar: Government usage	76	4.0
D. Impact subindex	**67**	**3.5**
9th pillar: Economic impacts	47	3.5
10th pillar: Social impacts	80	3.6



The Networked Readiness Index in detail

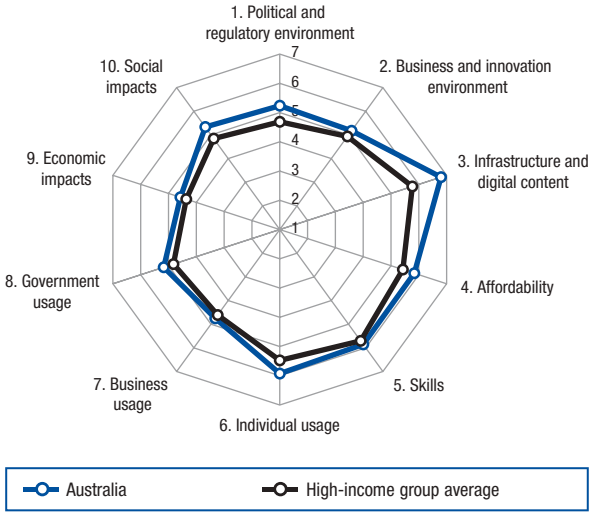
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	78	3.5
1.02	Laws relating to ICTs*	42	4.6
1.03	Judicial independence*	110	3.0
1.04	Efficiency of legal system in settling disputes*	74	3.7
1.05	Efficiency of legal system in challenging regs*	76	3.4
1.06	Intellectual property protection*	75	3.6
1.07	Software piracy rate, % software installed	101	88
1.08	No. procedures to enforce a contract	142	49
1.09	No. days to enforce a contract	80	570
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	97	4.5
2.02	Venture capital availability*	93	2.4
2.03	Total tax rate, % profits	77	38.8
2.04	No. days to start a business	9	4
2.05	No. procedures to start a business	3	2
2.06	Intensity of local competition*	102	4.6
2.07	Tertiary education gross enrollment rate, %	59	46.0
2.08	Quality of management schools*	120	3.4
2.09	Gov't procurement of advanced tech*	111	3.0
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	74	2507.7
3.02	Mobile network coverage, % pop.	43	99.8
3.03	Int'l Internet bandwidth, kb/s per user	47	40.4
3.04	Secure Internet servers/million pop.	72	26.9
3.05	Accessibility of digital content*	64	5.3
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	63	0.22
4.02	Fixed broadband Internet tariffs, PPP $/month	54	28.13
4.03	Internet & telephony competition, 0–2 (best)	113	1.25
	5th pillar: Skills		
5.01	Quality of educational system*	69	3.7
5.02	Quality of math & science education*	67	4.2
5.03	Secondary education gross enrollment rate, %	54	95.9
5.04	Adult literacy rate, %	11	99.6

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	65	111.9
6.02	Individuals using Internet, %	84	39.2
6.03	Households w/ personal computer, %	79	34.0
6.04	Households w/ Internet access, %	81	25.4
6.05	Fixed broadband Internet subs./100 pop.	74	6.7
6.06	Mobile broadband subscriptions/100 pop.	55	29.1
6.07	Use of virtual social networks*	67	5.8
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	98	4.4
7.02	Capacity for innovation*	77	3.4
7.03	PCT patents, applications/million pop.	50	3.5
7.04	Business-to-business Internet use*	48	5.2
7.05	Business-to-consumer Internet use*	78	4.4
7.06	Extent of staff training*	114	3.6
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	47	4.4
8.02	Government Online Service Index, 0–1 (best)	109	0.33
8.03	Gov't success in ICT promotion*	46	4.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	46	4.7
9.02	ICT PCT patents, applications/million pop.	53	0.5
9.03	Impact of ICTs on new organizational models*	36	4.7
9.04	Knowledge-intensive jobs, % workforce	62	24.1
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	64	4.3
10.02	Internet access in schools*	78	4.0
10.03	ICT use & gov't efficiency*	24	5.0
10.04	E-Participation Index, 0–1 (best)	127	0.00

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Australia

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**18**	**5.4**
Networked Readiness Index 2013 (out of 144)	18	5.3
A. Environment subindex	**14**	**5.2**
1st pillar: Political and regulatory environment	15	5.2
2nd pillar: Business and innovation environment	21	5.2
B. Readiness subindex	**9**	**6.2**
3rd pillar: Infrastructure and digital content	8	6.8
4th pillar: Affordability	49	5.8
5th pillar: Skills	20	5.8
C. Usage subindex	**19**	**5.3**
6th pillar: Individual usage	15	5.9
7th pillar: Business usage	24	4.8
8th pillar: Government usage	21	5.2
D. Impact subindex	**20**	**5.0**
9th pillar: Economic impacts	23	4.6
10th pillar: Social impacts	15	5.3



The Networked Readiness Index in detail

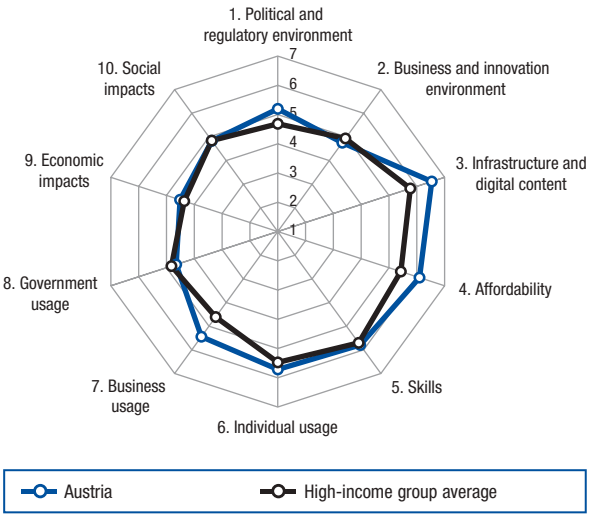
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	25	4.5
1.02	Laws relating to ICTs*	17	5.1
1.03	Judicial independence*	16	5.7
1.04	Efficiency of legal system in settling disputes*	30	4.6
1.05	Efficiency of legal system in challenging regs*	30	4.3
1.06	Intellectual property protection*	21	5.3
1.07	Software piracy rate, % software installed	5	23
1.08	No. procedures to enforce a contract	12	28
1.09	No. days to enforce a contract	26	395
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	23	6.1
2.02	Venture capital availability*	19	3.6
2.03	Total tax rate, % profits	108	47.0
2.04	No. days to start a business	5	3
2.05	No. procedures to start a business	10	3
2.06	Intensity of local competition*	13	5.8
2.07	Tertiary education gross enrollment rate, %	8	83.2
2.08	Quality of management schools*	29	5.1
2.09	Gov't procurement of advanced tech*	57	3.6
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	9	11120.8
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	33	69.1
3.04	Secure Internet servers/million pop.	8	1724.5
3.05	Accessibility of digital content*	22	6.1
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	26	0.10
4.02	Fixed broadband Internet tariffs, PPP $/month	101	41.30
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	23	4.8
5.02	Quality of math & science education*	37	4.6
5.03	Secondary education gross enrollment rate, %	1	133.0
5.04	Adult literacy rate, %	14	99.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	84	105.6
6.02	Individuals using Internet, %	18	82.4
6.03	Households w/ personal computer, %	17	85.2
6.04	Households w/ Internet access, %	17	81.4
6.05	Fixed broadband Internet subs./100 pop.	25	24.3
6.06	Mobile broadband subscriptions/100 pop.	7	96.2
6.07	Use of virtual social networks*	10	6.4
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	14	5.8
7.02	Capacity for innovation*	23	4.5
7.03	PCT patents, applications/million pop.	21	76.2
7.04	Business-to-business Internet use*	27	5.6
7.05	Business-to-consumer Internet use*	12	5.8
7.06	Extent of staff training*	30	4.5
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	25	4.7
8.02	Government Online Service Index, 0–1 (best)	9	0.86
8.03	Gov't success in ICT promotion*	48	4.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	22	5.1
9.02	ICT PCT patents, applications/million pop.	20	20.1
9.03	Impact of ICTs on new organizational models*	21	4.9
9.04	Knowledge-intensive jobs, % workforce	16	42.9
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	24	5.3
10.02	Internet access in schools*	17	5.9
10.03	ICT use & gov't efficiency*	51	4.5
10.04	E-Participation Index, 0–1 (best)	8	0.76

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Austria

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**22**	**5.3**
Networked Readiness Index 2013 (out of 144)	19	5.2
A. Environment subindex	**23**	**5.0**
1st pillar: Political and regulatory environment	18	5.2
2nd pillar: Business and innovation environment	39	4.8
B. Readiness subindex	**11**	**6.1**
3rd pillar: Infrastructure and digital content	10	6.5
4th pillar: Affordability	34	6.1
5th pillar: Skills	22	5.8
C. Usage subindex	**20**	**5.3**
6th pillar: Individual usage	20	5.7
7th pillar: Business usage	11	5.4
8th pillar: Government usage	36	4.6
D. Impact subindex	**24**	**4.7**
9th pillar: Economic impacts	24	4.5
10th pillar: Social impacts	31	4.8



The Networked Readiness Index in detail

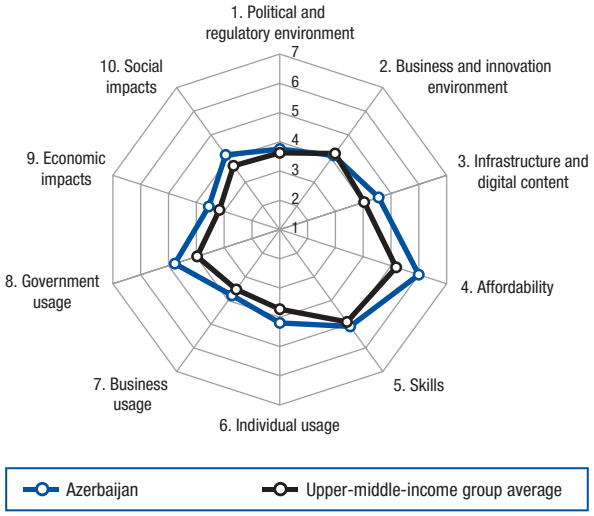
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	35	4.3
1.02	Laws relating to ICTs*	21	5.1
1.03	Judicial independence*	30	5.1
1.04	Efficiency of legal system in settling disputes*	24	4.8
1.05	Efficiency of legal system in challenging regs*	25	4.4
1.06	Intellectual property protection*	17	5.5
1.07	Software piracy rate, % software installed	5	23
1.08	No. procedures to enforce a contract	4	25
1.09	No. days to enforce a contract	29	397
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	24	6.1
2.02	Venture capital availability*	55	2.8
2.03	Total tax rate, % profits	125	52.4
2.04	No. days to start a business	103	25
2.05	No. procedures to start a business	94	8
2.06	Intensity of local competition*	11	5.8
2.07	Tertiary education gross enrollment rate, %	25	71.0
2.08	Quality of management schools*	40	4.7
2.09	Gov't procurement of advanced tech*	47	3.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	26	7618.2
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	17	108.1
3.04	Secure Internet servers/million pop.	16	1134.7
3.05	Accessibility of digital content*	15	6.2
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	20	0.08
4.02	Fixed broadband Internet tariffs, PPP $/month	87	35.98
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	24	4.8
5.02	Quality of math & science education*	39	4.6
5.03	Secondary education gross enrollment rate, %	41	98.0
5.04	Adult literacy rate, %	14	99.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	11	160.5
6.02	Individuals using Internet, %	21	81.0
6.03	Households w/ personal computer, %	22	81.0
6.04	Households w/ Internet access, %	20	79.0
6.05	Fixed broadband Internet subs./100 pop.	23	25.0
6.06	Mobile broadband subscriptions/100 pop.	23	56.3
6.07	Use of virtual social networks*	21	6.2
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	17	5.8
7.02	Capacity for innovation*	14	5.0
7.03	PCT patents, applications/million pop.	10	159.6
7.04	Business-to-business Internet use*	9	5.9
7.05	Business-to-consumer Internet use*	17	5.6
7.06	Extent of staff training*	16	4.9
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	69	3.9
8.02	Government Online Service Index, 0–1 (best)	26	0.75
8.03	Gov't success in ICT promotion*	56	4.5
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	36	4.9
9.02	ICT PCT patents, applications/million pop.	13	31.0
9.03	Impact of ICTs on new organizational models*	48	4.5
9.04	Knowledge-intensive jobs, % workforce	25	38.5
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	23	5.3
10.02	Internet access in schools*	25	5.7
10.03	ICT use & gov't efficiency*	22	5.1
10.04	E-Participation Index, 0–1 (best)	41	0.37

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Azerbaijan

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**49**	**4.3**
Networked Readiness Index 2013 (out of 144)	56	4.1
A. Environment subindex	**70**	**3.9**
1st pillar: Political and regulatory environment	66	3.7
2nd pillar: Business and innovation environment	77	4.1
B. Readiness subindex	**49**	**5.2**
3rd pillar: Infrastructure and digital content	55	4.6
4th pillar: Affordability	40	6.0
5th pillar: Skills	66	5.1
C. Usage subindex	**44**	**4.2**
6th pillar: Individual usage	61	4.2
7th pillar: Business usage	52	3.8
8th pillar: Government usage	34	4.8
D. Impact subindex	**46**	**3.8**
9th pillar: Economic impacts	42	3.6
10th pillar: Social impacts	46	4.1



The Networked Readiness Index in detail

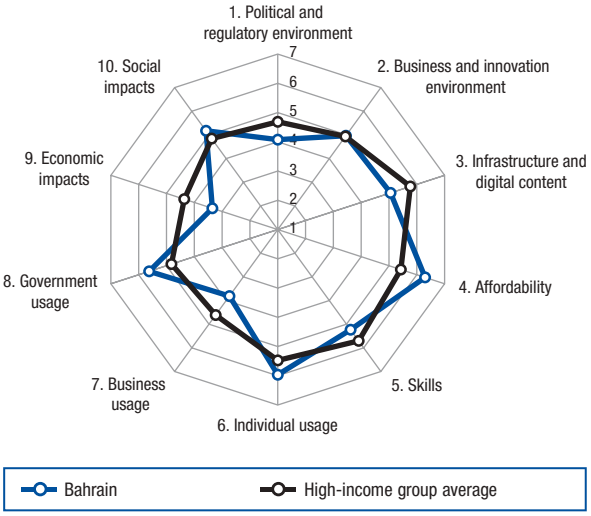
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	63	3.7
1.02	Laws relating to ICTs*	24	5.1
1.03	Judicial independence*	93	3.3
1.04	Efficiency of legal system in settling disputes*	64	3.8
1.05	Efficiency of legal system in challenging regs*	53	3.7
1.06	Intellectual property protection*	69	3.7
1.07	Software piracy rate, % software installed	100	87
1.08	No. procedures to enforce a contract	98	40
1.09	No. days to enforce a contract	6	237
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	65	5.0
2.02	Venture capital availability*	52	2.9
2.03	Total tax rate, % profits	81	40.0
2.04	No. days to start a business	37	7
2.05	No. procedures to start a business	10	3
2.06	Intensity of local competition*	128	4.2
2.07	Tertiary education gross enrollment rate, %	96	19.6
2.08	Quality of management schools*	134	3.1
2.09	Gov't procurement of advanced tech*	14	4.4
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	81	2212.3
3.02	Mobile network coverage, % pop.	1	100.0
3.03	Int'l Internet bandwidth, kb/s per user	45	40.6
3.04	Secure Internet servers/million pop.	101	6.5
3.05	Accessibility of digital content*	50	5.4
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	65	0.22
4.02	Fixed broadband Internet tariffs, PPP $/month	18	17.99
4.03	Internet & telephony competition, 0–2 (best)	102	1.40
	5th pillar: Skills		
5.01	Quality of educational system*	114	3.1
5.02	Quality of math & science education*	110	3.3
5.03	Secondary education gross enrollment rate, %	38	99.5
5.04	Adult literacy rate, %	3	99.8

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	73	108.8
6.02	Individuals using Internet, %	59	54.2
6.03	Households w/ personal computer, %	67	45.0
6.04	Households w/ Internet access, %	61	46.8
6.05	Fixed broadband Internet subs./100 pop.	46	14.1
6.06	Mobile broadband subscriptions/100 pop.	46	34.8
6.07	Use of virtual social networks*	38	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	59	4.9
7.02	Capacity for innovation*	35	4.1
7.03	PCT patents, applications/million pop.	77	0.6
7.04	Business-to-business Internet use*	47	5.2
7.05	Business-to-consumer Internet use*	51	4.9
7.06	Extent of staff training*	80	3.9
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	6	5.5
8.02	Government Online Service Index, 0–1 (best)	98	0.37
8.03	Gov't success in ICT promotion*	8	5.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	43	4.8
9.02	ICT PCT patents, applications/million pop.	75	0.1
9.03	Impact of ICTs on new organizational models*	24	4.9
9.04	Knowledge-intensive jobs, % workforce	60	24.2
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	31	5.2
10.02	Internet access in schools*	72	4.2
10.03	ICT use & gov't efficiency*	11	5.4
10.04	E-Participation Index, 0–1 (best)	82	0.13

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Bahrain

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**29**	**4.9**
Networked Readiness Index 2013 (out of 144)	29	4.8
A. Environment subindex	**40**	**4.5**
1st pillar: Political and regulatory environment	48	4.1
2nd pillar: Business and innovation environment	27	5.0
B. Readiness subindex	**32**	**5.5**
3rd pillar: Infrastructure and digital content	39	5.0
4th pillar: Affordability	25	6.3
5th pillar: Skills	58	5.2
C. Usage subindex	**25**	**5.1**
6th pillar: Individual usage	14	6.0
7th pillar: Business usage	49	3.8
8th pillar: Government usage	5	5.6
D. Impact subindex	**35**	**4.3**
9th pillar: Economic impacts	63	3.4
10th pillar: Social impacts	18	5.2



The Networked Readiness Index in detail

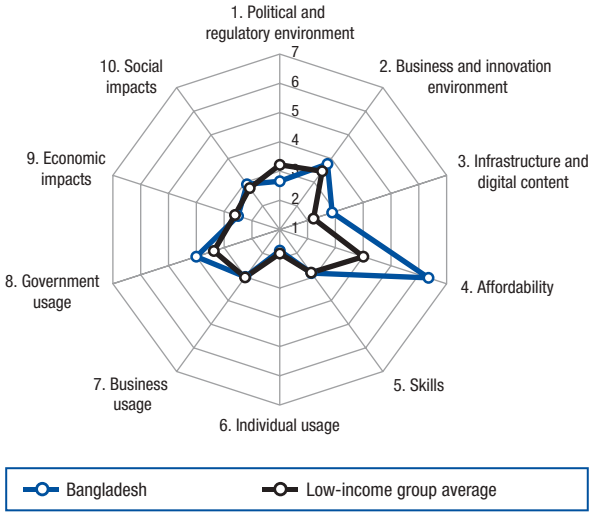
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	85	3.4
1.02	Laws relating to ICTs*	40	4.7
1.03	Judicial independence*	46	4.5
1.04	Efficiency of legal system in settling disputes*	41	4.2
1.05	Efficiency of legal system in challenging regs*	43	3.9
1.06	Intellectual property protection*	32	4.8
1.07	Software piracy rate, % software installed	44	54
1.08	No. procedures to enforce a contract	141	48
1.09	No. days to enforce a contract	102	635
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	26	6.0
2.02	Venture capital availability*	15	3.8
2.03	Total tax rate, % profits	5	13.5
2.04	No. days to start a business	51	9
2.05	No. procedures to start a business	79	7
2.06	Intensity of local competition*	40	5.3
2.07	Tertiary education gross enrollment rate, %	77	33.5
2.08	Quality of management schools*	85	4.1
2.09	Gov't procurement of advanced tech*	24	4.1
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	12	10694.9
3.02	Mobile network coverage, % pop.	1	100.0
3.03	Int'l Internet bandwidth, kb/s per user	74	18.1
3.04	Secure Internet servers/million pop.	45	135.8
3.05	Accessibility of digital content*	38	5.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	32	0.13
4.02	Fixed broadband Internet tariffs, PPP $/month	55	28.21
4.03	Internet & telephony competition, 0–2 (best)	63	1.92
	5th pillar: Skills		
5.01	Quality of educational system*	48	4.1
5.02	Quality of math & science education*	77	4.0
5.03	Secondary education gross enrollment rate, %	56	95.5
5.04	Adult literacy rate, %	80	91.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	10	161.2
6.02	Individuals using Internet, %	10	88.0
6.03	Households w/ personal computer, %	3	92.7
6.04	Households w/ Internet access, %	20	79.0
6.05	Fixed broadband Internet subs./100 pop.	49	13.2
6.06	Mobile broadband subscriptions/100 pop.	8	91.2
6.07	Use of virtual social networks*	12	6.3
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	30	5.5
7.02	Capacity for innovation*	82	3.4
7.03	PCT patents, applications/million pop.	69	1.0
7.04	Business-to-business Internet use*	38	5.4
7.05	Business-to-consumer Internet use*	87	4.2
7.06	Extent of staff training*	41	4.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	14	5.2
8.02	Government Online Service Index, 0–1 (best)	9	0.86
8.03	Gov't success in ICT promotion*	12	5.5
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	49	4.7
9.02	ICT PCT patents, applications/million pop.	52	0.5
9.03	Impact of ICTs on new organizational models*	46	4.5
9.04	Knowledge-intensive jobs, % workforce	74	20.7
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	18	5.4
10.02	Internet access in schools*	45	5.0
10.03	ICT use & gov't efficiency*	13	5.4
10.04	E-Participation Index, 0–1 (best)	19	0.66

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Bangladesh

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**119**	**3.2**
Networked Readiness Index 2013 (out of 144)	114	3.2
A. Environment subindex	**132**	**3.2**
1st pillar: Political and regulatory environment	138	2.7
2nd pillar: Business and innovation environment	114	3.8
B. Readiness subindex	**104**	**4.0**
3rd pillar: Infrastructure and digital content	112	2.9
4th pillar: Affordability	23	6.3
5th pillar: Skills	128	2.8
C. Usage subindex	**120**	**2.9**
6th pillar: Individual usage	134	1.7
7th pillar: Business usage	127	3.0
8th pillar: Government usage	73	4.0
D. Impact subindex	**127**	**2.7**
9th pillar: Economic impacts	130	2.5
10th pillar: Social impacts	118	2.9



The Networked Readiness Index in detail

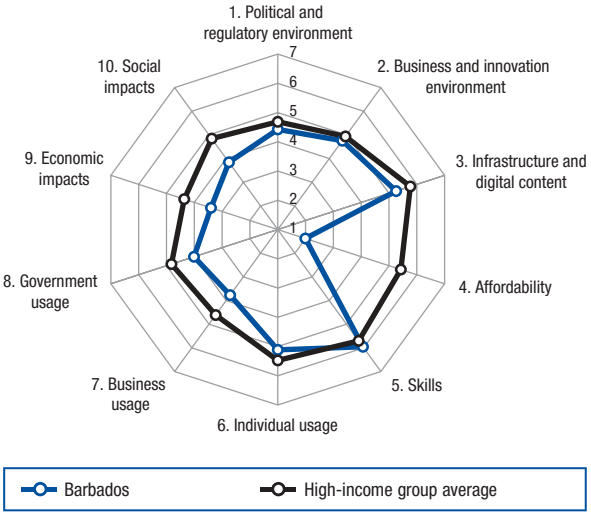
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	101	3.2
1.02	Laws relating to ICTs*	123	3.0
1.03	Judicial independence*	129	2.4
1.04	Efficiency of legal system in settling disputes*	114	3.1
1.05	Efficiency of legal system in challenging regs*	81	3.3
1.06	Intellectual property protection*	130	2.6
1.07	Software piracy rate, % software installed	104	90
1.08	No. procedures to enforce a contract	111	41
1.09	No. days to enforce a contract	147	1442
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	101	4.4
2.02	Venture capital availability*	125	2.0
2.03	Total tax rate, % profits	62	35.0
2.04	No. days to start a business	57	11
2.05	No. procedures to start a business	79	7
2.06	Intensity of local competition*	74	4.9
2.07	Tertiary education gross enrollment rate, %	109	13.2
2.08	Quality of management schools*	105	3.7
2.09	Gov't procurement of advanced tech*	142	2.4
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	118	288.2
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	128	3.0
3.04	Secure Internet servers/million pop.	136	0.7
3.05	Accessibility of digital content*	117	4.0
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	5	0.04
4.02	Fixed broadband Internet tariffs, PPP $/month	3	10.37
4.03	Internet & telephony competition, 0–2 (best)	113	1.25
	5th pillar: Skills		
5.01	Quality of educational system*	98	3.3
5.02	Quality of math & science education*	112	3.3
5.03	Secondary education gross enrollment rate, %	119	50.8
5.04	Adult literacy rate, %	132	57.7

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	128	62.8
6.02	Individuals using Internet, %	128	6.3
6.03	Households w/ personal computer, %	130	4.8
6.04	Households w/ Internet access, %	133	3.2
6.05	Fixed broadband Internet subs./100 pop.	117	0.4
6.06	Mobile broadband subscriptions/100 pop.	127	0.5
6.07	Use of virtual social networks*	138	4.4
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	111	4.2
7.02	Capacity for innovation*	120	3.0
7.03	PCT patents, applications/million pop.	117	0.0
7.04	Business-to-business Internet use*	130	4.0
7.05	Business-to-consumer Internet use*	124	3.5
7.06	Extent of staff training*	137	3.1
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	65	4.1
8.02	Government Online Service Index, 0–1 (best)	84	0.44
8.03	Gov't success in ICT promotion*	76	4.3
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	112	3.8
9.02	ICT PCT patents, applications/million pop.	92	0.0
9.03	Impact of ICTs on new organizational models*	119	3.5
9.04	Knowledge-intensive jobs, % workforce	109	7.3
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	96	3.7
10.02	Internet access in schools*	122	2.8
10.03	ICT use & gov't efficiency*	107	3.6
10.04	E-Participation Index, 0–1 (best)	97	0.08

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Barbados

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**55**	**4.2**
Networked Readiness Index 2013 (out of 144)	39	4.5
A. Environment subindex	**38**	**4.6**
1st pillar: Political and regulatory environment	35	4.4
2nd pillar: Business and innovation environment	42	4.7
B. Readiness subindex	**91**	**4.4**
3rd pillar: Infrastructure and digital content	35	5.3
4th pillar: Affordability	144	2.0
5th pillar: Skills	15	5.9
C. Usage subindex	**43**	**4.3**
6th pillar: Individual usage	33	5.1
7th pillar: Business usage	53	3.8
8th pillar: Government usage	72	4.0
D. Impact subindex	**58**	**3.6**
9th pillar: Economic impacts	57	3.4
10th pillar: Social impacts	64	3.8



The Networked Readiness Index in detail

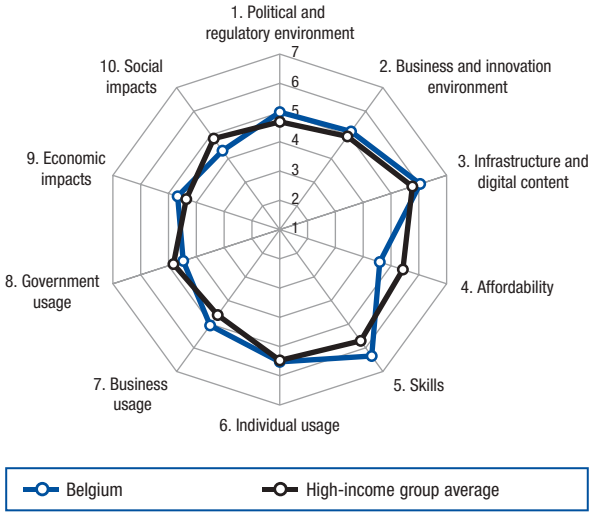
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	15	5.0
1.02	Laws relating to ICTs*	64	4.1
1.03	Judicial independence*	21	5.5
1.04	Efficiency of legal system in settling disputes*	34	4.5
1.05	Efficiency of legal system in challenging regs*	32	4.2
1.06	Intellectual property protection*	37	4.5
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	78	38
1.09	No. days to enforce a contract	143	1340
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	28	5.9
2.02	Venture capital availability*	98	2.4
2.03	Total tax rate, % profits	87	40.8
2.04	No. days to start a business	86	18
2.05	No. procedures to start a business	94	8
2.06	Intensity of local competition*	50	5.2
2.07	Tertiary education gross enrollment rate, %	37	60.8
2.08	Quality of management schools*	26	5.1
2.09	Gov't procurement of advanced tech*	54	3.6
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	60	3698.3
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	34	67.4
3.04	Secure Internet servers/million pop.	30	374.3
3.05	Accessibility of digital content*	28	6.0
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	136	0.59
4.02	Fixed broadband Internet tariffs, PPP $/month	129	80.33
4.03	Internet & telephony competition, 0–2 (best)	118	1.20
	5th pillar: Skills		
5.01	Quality of educational system*	6	5.3
5.02	Quality of math & science education*	9	5.5
5.03	Secondary education gross enrollment rate, %	23	104.7
5.04	Adult literacy rate, %	n/a	n/a

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	46	122.5
6.02	Individuals using Internet, %	32	73.3
6.03	Households w/ personal computer, %	41	69.2
6.04	Households w/ Internet access, %	44	62.9
6.05	Fixed broadband Internet subs./100 pop.	30	23.1
6.06	Mobile broadband subscriptions/100 pop.	44	36.0
6.07	Use of virtual social networks*	25	6.2
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	44	5.2
7.02	Capacity for innovation*	81	3.4
7.03	PCT patents, applications/million pop.	43	6.2
7.04	Business-to-business Internet use*	70	4.8
7.05	Business-to-consumer Internet use*	79	4.4
7.06	Extent of staff training*	32	4.5
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	53	4.3
8.02	Government Online Service Index, 0–1 (best)	96	0.37
8.03	Gov't success in ICT promotion*	57	4.5
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	74	4.3
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	76	4.1
9.04	Knowledge-intensive jobs, % workforce	47	30.3
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	42	4.8
10.02	Internet access in schools*	38	5.1
10.03	ICT use & gov't efficiency*	60	4.3
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Belgium

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**27**	**5.1**
Networked Readiness Index 2013 (out of 144)	24	5.1
A. Environment subindex	**19**	**5.1**
1st pillar: Political and regulatory environment	21	5.0
2nd pillar: Business and innovation environment	22	5.1
B. Readiness subindex	**25**	**5.7**
3rd pillar: Infrastructure and digital content	22	6.0
4th pillar: Affordability	101	4.6
5th pillar: Skills	4	6.3
C. Usage subindex	**27**	**5.0**
6th pillar: Individual usage	25	5.5
7th pillar: Business usage	18	5.1
8th pillar: Government usage	42	4.5
D. Impact subindex	**29**	**4.5**
9th pillar: Economic impacts	20	4.7
10th pillar: Social impacts	40	4.3



The Networked Readiness Index in detail

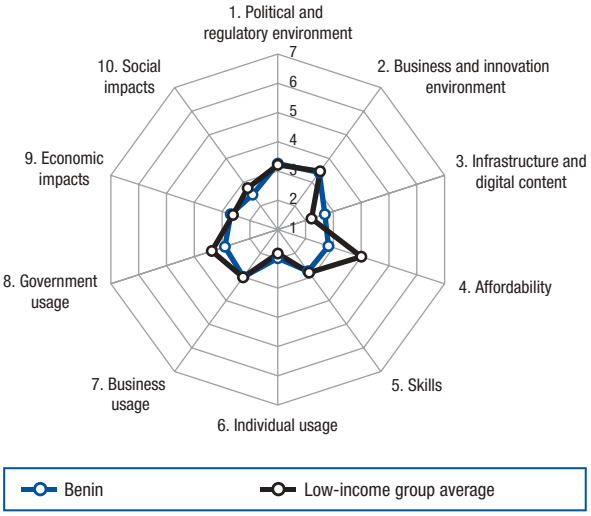
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	49	4.0
1.02	Laws relating to ICTs*	30	4.9
1.03	Judicial independence*	24	5.4
1.04	Efficiency of legal system in settling disputes*	40	4.2
1.05	Efficiency of legal system in challenging regs*	36	4.0
1.06	Intellectual property protection*	22	5.2
1.07	Software piracy rate, % software installed	7	24
1.08	No. procedures to enforce a contract	5	26
1.09	No. days to enforce a contract	58	505
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	12	6.3
2.02	Venture capital availability*	26	3.3
2.03	Total tax rate, % profits	130	57.5
2.04	No. days to start a business	9	4
2.05	No. procedures to start a business	10	3
2.06	Intensity of local competition*	6	6.0
2.07	Tertiary education gross enrollment rate, %	27	69.3
2.08	Quality of management schools*	2	6.0
2.09	Gov't procurement of advanced tech*	45	3.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	31	6935.1
3.02	Mobile network coverage, % pop.	33	99.9
3.03	Int'l Internet bandwidth, kb/s per user	11	180.4
3.04	Secure Internet servers/million pop.	22	673.6
3.05	Accessibility of digital content*	26	6.0
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	135	0.59
4.02	Fixed broadband Internet tariffs, PPP $/month	64	29.39
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	7	5.3
5.02	Quality of math & science education*	3	6.0
5.03	Secondary education gross enrollment rate, %	19	106.5
5.04	Adult literacy rate, %	14	99.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	68	111.3
6.02	Individuals using Internet, %	19	82.0
6.03	Households w/ personal computer, %	25	80.0
6.04	Households w/ Internet access, %	23	78.0
6.05	Fixed broadband Internet subs./100 pop.	10	33.3
6.06	Mobile broadband subscriptions/100 pop.	51	33.0
6.07	Use of virtual social networks*	28	6.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	26	5.6
7.02	Capacity for innovation*	10	5.1
7.03	PCT patents, applications/million pop.	16	110.7
7.04	Business-to-business Internet use*	26	5.6
7.05	Business-to-consumer Internet use*	34	5.1
7.06	Extent of staff training*	19	4.9
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	63	4.1
8.02	Government Online Service Index, 0–1 (best)	39	0.65
8.03	Gov't success in ICT promotion*	68	4.4
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	30	5.0
9.02	ICT PCT patents, applications/million pop.	17	25.4
9.03	Impact of ICTs on new organizational models*	30	4.8
9.04	Knowledge-intensive jobs, % workforce	11	44.6
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	19	5.4
10.02	Internet access in schools*	26	5.7
10.03	ICT use & gov't efficiency*	52	4.5
10.04	E-Participation Index, 0–1 (best)	82	0.13

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Benin

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**135**	**2.8**
Networked Readiness Index 2013 (out of 144)	123	3.0
A. Environment subindex	**127**	**3.3**
1st pillar: Political and regulatory environment	107	3.2
2nd pillar: Business and innovation environment	131	3.4
B. Readiness subindex	**134**	**2.8**
3rd pillar: Infrastructure and digital content	122	2.7
4th pillar: Affordability	134	2.8
5th pillar: Skills	130	2.8
C. Usage subindex	**137**	**2.6**
6th pillar: Individual usage	124	2.0
7th pillar: Business usage	128	3.0
8th pillar: Government usage	137	2.9
D. Impact subindex	**132**	**2.6**
9th pillar: Economic impacts	119	2.7
10th pillar: Social impacts	136	2.5



The Networked Readiness Index in detail

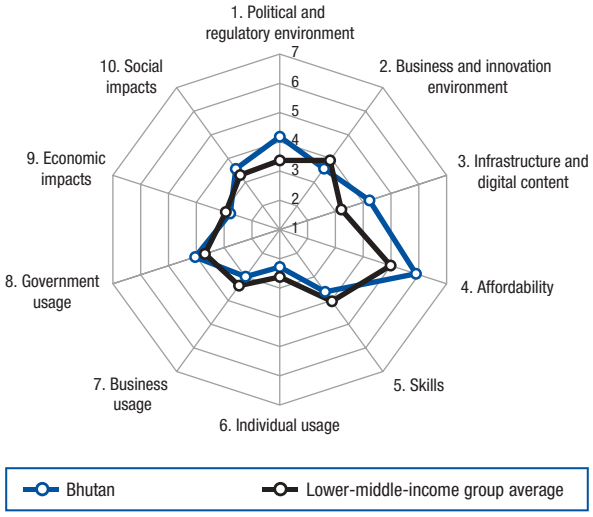
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	45	4.1
1.02	Laws relating to ICTs*	135	2.6
1.03	Judicial independence*	116	2.7
1.04	Efficiency of legal system in settling disputes*	104	3.3
1.05	Efficiency of legal system in challenging regs*	91	3.2
1.06	Intellectual property protection*	101	3.1
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	116	42
1.09	No. days to enforce a contract	119	795
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	131	3.8
2.02	Venture capital availability*	113	2.2
2.03	Total tax rate, % profits	139	65.9
2.04	No. days to start a business	76	15
2.05	No. procedures to start a business	22	4
2.06	Intensity of local competition*	89	4.7
2.07	Tertiary education gross enrollment rate, %	111	12.4
2.08	Quality of management schools*	73	4.3
2.09	Gov't procurement of advanced tech*	100	3.2
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	146	15.7
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	126	3.2
3.04	Secure Internet servers/million pop.	137	0.7
3.05	Accessibility of digital content*	141	3.2
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	72	0.24
4.02	Fixed broadband Internet tariffs, PPP $/month	132	101.41
4.03	Internet & telephony competition, 0–2 (best)	139	0.50
	5th pillar: Skills		
5.01	Quality of educational system*	101	3.2
5.02	Quality of math & science education*	66	4.2
5.03	Secondary education gross enrollment rate, %	123	47.7
5.04	Adult literacy rate, %	142	42.4

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	110	83.7
6.02	Individuals using Internet, %	136	3.8
6.03	Households w/ personal computer, %	131	4.2
6.04	Households w/ Internet access, %	139	2.4
6.05	Fixed broadband Internet subs./100 pop.	134	0.1
6.06	Mobile broadband subscriptions/100 pop.	129	0.4
6.07	Use of virtual social networks*	125	4.8
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	122	4.0
7.02	Capacity for innovation*	114	3.0
7.03	PCT patents, applications/million pop.	122	0.0
7.04	Business-to-business Internet use*	129	4.0
7.05	Business-to-consumer Internet use*	112	3.7
7.06	Extent of staff training*	136	3.1
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	124	3.1
8.02	Government Online Service Index, 0–1 (best)	130	0.20
8.03	Gov't success in ICT promotion*	129	3.4
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	99	4.0
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	132	3.1
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	131	3.2
10.02	Internet access in schools*	140	2.0
10.03	ICT use & gov't efficiency*	127	3.2
10.04	E-Participation Index, 0–1 (best)	97	0.08

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Bhutan

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**94**	**3.7**
Networked Readiness Index 2013 (out of 144)	n/a	n/a
A. Environment subindex	**76**	**3.9**
1st pillar: Political and regulatory environment	43	4.2
2nd pillar: Business and innovation environment	123	3.6
B. Readiness subindex	**84**	**4.6**
3rd pillar: Infrastructure and digital content	67	4.2
4th pillar: Affordability	45	5.9
5th pillar: Skills	114	3.6
C. Usage subindex	**110**	**3.1**
6th pillar: Individual usage	114	2.3
7th pillar: Business usage	130	3.0
8th pillar: Government usage	70	4.0
D. Impact subindex	**97**	**3.2**
9th pillar: Economic impacts	112	2.8
10th pillar: Social impacts	81	3.6



The Networked Readiness Index in detail

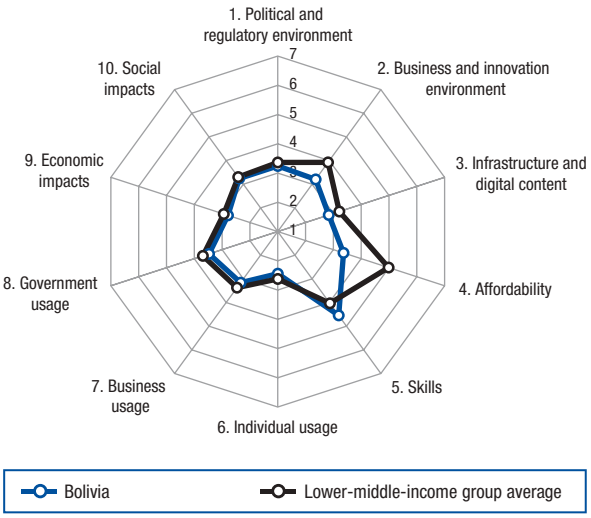
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	22	4.7
1.02	Laws relating to ICTs*	96	3.5
1.03	Judicial independence*	38	4.8
1.04	Efficiency of legal system in settling disputes*	51	4.0
1.05	Efficiency of legal system in challenging regs*	87	3.3
1.06	Intellectual property protection*	44	4.1
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	138	47
1.09	No. days to enforce a contract	3	225
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	135	3.7
2.02	Venture capital availability*	107	2.2
2.03	Total tax rate, % profits	87	40.8
2.04	No. days to start a business	114	32
2.05	No. procedures to start a business	94	8
2.06	Intensity of local competition*	96	4.7
2.07	Tertiary education gross enrollment rate, %	124	8.7
2.08	Quality of management schools*	111	3.6
2.09	Gov't procurement of advanced tech*	48	3.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	15	9688.6
3.02	Mobile network coverage, % pop.	1	100.0
3.03	Int'l Internet bandwidth, kb/s per user	124	3.3
3.04	Secure Internet servers/million pop.	88	12.1
3.05	Accessibility of digital content*	90	4.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	38	0.14
4.02	Fixed broadband Internet tariffs, PPP $/month	44	25.66
4.03	Internet & telephony competition, 0–2 (best)	104	1.33
	5th pillar: Skills		
5.01	Quality of educational system*	41	4.3
5.02	Quality of math & science education*	71	4.1
5.03	Secondary education gross enrollment rate, %	101	73.9
5.04	Adult literacy rate, %	137	52.8

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	118	75.6
6.02	Individuals using Internet, %	100	25.4
6.03	Households w/ personal computer, %	101	16.4
6.04	Households w/ Internet access, %	102	11.6
6.05	Fixed broadband Internet subs./100 pop.	93	2.3
6.06	Mobile broadband subscriptions/100 pop.	115	2.5
6.07	Use of virtual social networks*	106	5.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	138	3.7
7.02	Capacity for innovation*	78	3.4
7.03	PCT patents, applications/million pop.	82	0.4
7.04	Business-to-business Internet use*	134	3.8
7.05	Business-to-consumer Internet use*	141	3.0
7.06	Extent of staff training*	119	3.4
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	33	4.5
8.02	Government Online Service Index, 0–1 (best)	102	0.35
8.03	Gov't success in ICT promotion*	61	4.5
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	110	3.9
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	114	3.6
9.04	Knowledge-intensive jobs, % workforce	90	16.5
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	50	4.5
10.02	Internet access in schools*	88	3.8
10.03	ICT use & gov't efficiency*	43	4.7
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Bolivia

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**120**	**3.2**
Networked Readiness Index 2013 (out of 144)	119	3.0
A. Environment subindex	**131**	**3.2**
1st pillar: Political and regulatory environment	109	3.2
2nd pillar: Business and innovation environment	139	3.2
B. Readiness subindex	**115**	**3.6**
3rd pillar: Infrastructure and digital content	114	2.8
4th pillar: Affordability	126	3.4
5th pillar: Skills	93	4.5
C. Usage subindex	**116**	**3.0**
6th pillar: Individual usage	108	2.4
7th pillar: Business usage	118	3.2
8th pillar: Government usage	115	3.5
D. Impact subindex	**104**	**3.0**
9th pillar: Economic impacts	111	2.8
10th pillar: Social impacts	101	3.2



The Networked Readiness Index in detail

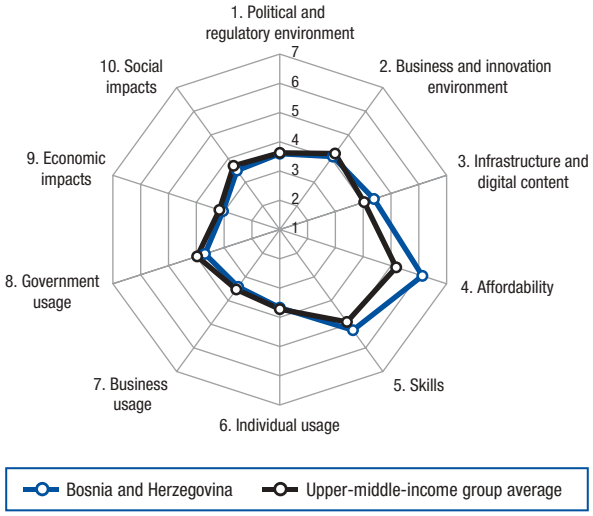
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	86	3.3
1.02	Laws relating to ICTs*	118	3.1
1.03	Judicial independence*	102	3.1
1.04	Efficiency of legal system in settling disputes*	82	3.6
1.05	Efficiency of legal system in challenging regs*	88	3.3
1.06	Intellectual property protection*	98	3.2
1.07	Software piracy rate, % software installed	83	79
1.08	No. procedures to enforce a contract	98	40
1.09	No. days to enforce a contract	88	591
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	130	3.8
2.02	Venture capital availability*	32	3.2
2.03	Total tax rate, % profits	145	83.4
2.04	No. days to start a business	132	49
2.05	No. procedures to start a business	144	15
2.06	Intensity of local competition*	137	3.8
2.07	Tertiary education gross enrollment rate, %	72	37.7
2.08	Quality of management schools*	126	3.3
2.09	Gov't procurement of advanced tech*	74	3.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	106	699.5
3.02	Mobile network coverage, % pop.	101	95.0
3.03	Int'l Internet bandwidth, kb/s per user	113	5.2
3.04	Secure Internet servers/million pop.	94	9.7
3.05	Accessibility of digital content*	130	3.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	126	0.51
4.02	Fixed broadband Internet tariffs, PPP $/month	111	49.63
4.03	Internet & telephony competition, 0–2 (best)	136	0.80
	5th pillar: Skills		
5.01	Quality of educational system*	89	3.4
5.02	Quality of math & science education*	98	3.6
5.03	Secondary education gross enrollment rate, %	95	77.3
5.04	Adult literacy rate, %	84	91.2

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	104	90.4
6.02	Individuals using Internet, %	91	34.2
6.03	Households w/ personal computer, %	88	25.9
6.04	Households w/ Internet access, %	107	10.0
6.05	Fixed broadband Internet subs./100 pop.	107	1.1
6.06	Mobile broadband subscriptions/100 pop.	98	6.6
6.07	Use of virtual social networks*	145	3.8
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	125	3.9
7.02	Capacity for innovation*	70	3.5
7.03	PCT patents, applications/million pop.	99	0.1
7.04	Business-to-business Internet use*	137	3.7
7.05	Business-to-consumer Internet use*	108	3.9
7.06	Extent of staff training*	112	3.6
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	112	3.4
8.02	Government Online Service Index, 0–1 (best)	92	0.41
8.03	Gov't success in ICT promotion*	119	3.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	107	3.9
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	100	3.7
9.04	Knowledge-intensive jobs, % workforce	95	15.3
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	99	3.7
10.02	Internet access in schools*	100	3.5
10.03	ICT use & gov't efficiency*	115	3.4
10.04	E-Participation Index, 0–1 (best)	63	0.21

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Bosnia and Herzegovina

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**68**	**4.0**
Networked Readiness Index 2013 (out of 144)	78	3.8
A. Environment subindex	**80**	**3.8**
1st pillar: Political and regulatory environment	76	3.6
2nd pillar: Business and innovation environment	83	4.1
B. Readiness subindex	**46**	**5.2**
3rd pillar: Infrastructure and digital content	63	4.4
4th pillar: Affordability	30	6.1
5th pillar: Skills	57	5.3
C. Usage subindex	**79**	**3.6**
6th pillar: Individual usage	70	3.7
7th pillar: Business usage	92	3.4
8th pillar: Government usage	99	3.7
D. Impact subindex	**87**	**3.3**
9th pillar: Economic impacts	88	3.0
10th pillar: Social impacts	85	3.5



The Networked Readiness Index in detail

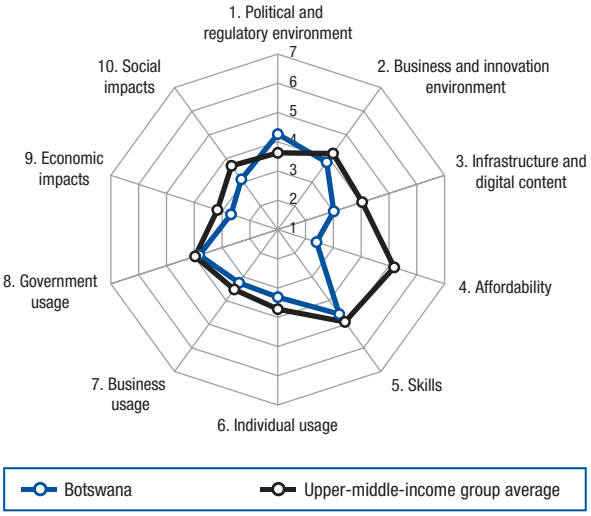
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	73	3.6
1.02	Laws relating to ICTs*	67	4.0
1.03	Judicial independence*	64	3.9
1.04	Efficiency of legal system in settling disputes*	85	3.5
1.05	Efficiency of legal system in challenging regs*	54	3.7
1.06	Intellectual property protection*	135	2.5
1.07	Software piracy rate, % software installed	62	66
1.08	No. procedures to enforce a contract	67	37
1.09	No. days to enforce a contract	90	595
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	76	4.9
2.02	Venture capital availability*	131	1.9
2.03	Total tax rate, % profits	24	25.5
2.04	No. days to start a business	124	37
2.05	No. procedures to start a business	129	11
2.06	Intensity of local competition*	143	3.4
2.07	Tertiary education gross enrollment rate, %	71	37.7
2.08	Quality of management schools*	41	4.7
2.09	Gov't procurement of advanced tech*	89	3.4
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	57	3979.9
3.02	Mobile network coverage, % pop.	43	99.8
3.03	Int'l Internet bandwidth, kb/s per user	65	23.9
3.04	Secure Internet servers/million pop.	74	25.8
3.05	Accessibility of digital content*	36	5.8
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	88	0.31
4.02	Fixed broadband Internet tariffs, PPP $/month	15	15.85
4.03	Internet & telephony competition, 0–2 (best)	74	1.86
	5th pillar: Skills		
5.01	Quality of educational system*	132	2.7
5.02	Quality of math & science education*	13	5.4
5.03	Secondary education gross enrollment rate, %	75	89.3
5.04	Adult literacy rate, %	49	98.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	105	87.6
6.02	Individuals using Internet, %	40	65.4
6.03	Households w/ personal computer, %	73	39.8
6.04	Households w/ Internet access, %	70	39.7
6.05	Fixed broadband Internet subs./100 pop.	58	10.6
6.06	Mobile broadband subscriptions/100 pop.	83	12.2
6.07	Use of virtual social networks*	44	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	93	4.4
7.02	Capacity for innovation*	108	3.1
7.03	PCT patents, applications/million pop.	57	2.0
7.04	Business-to-business Internet use*	101	4.5
7.05	Business-to-consumer Internet use*	88	4.2
7.06	Extent of staff training*	58	4.1
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	86	3.7
8.02	Government Online Service Index, 0–1 (best)	96	0.37
8.03	Gov't success in ICT promotion*	89	4.1
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	91	4.1
9.02	ICT PCT patents, applications/million pop.	64	0.2
9.03	Impact of ICTs on new organizational models*	81	4.0
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	65	4.3
10.02	Internet access in schools*	61	4.5
10.03	ICT use & gov't efficiency*	64	4.2
10.04	E-Participation Index, 0–1 (best)	127	0.00

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Botswana

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**103**	**3.4**
Networked Readiness Index 2013 (out of 144)	96	3.5
A. Environment subindex	**61**	**4.1**
1st pillar: Political and regulatory environment	40	4.3
2nd pillar: Business and innovation environment	107	3.8
B. Readiness subindex	**118**	**3.3**
3rd pillar: Infrastructure and digital content	109	3.0
4th pillar: Affordability	142	2.4
5th pillar: Skills	92	4.6
C. Usage subindex	**88**	**3.5**
6th pillar: Individual usage	79	3.3
7th pillar: Business usage	106	3.2
8th pillar: Government usage	86	3.8
D. Impact subindex	**110**	**2.9**
9th pillar: Economic impacts	120	2.7
10th pillar: Social impacts	107	3.1



The Networked Readiness Index in detail

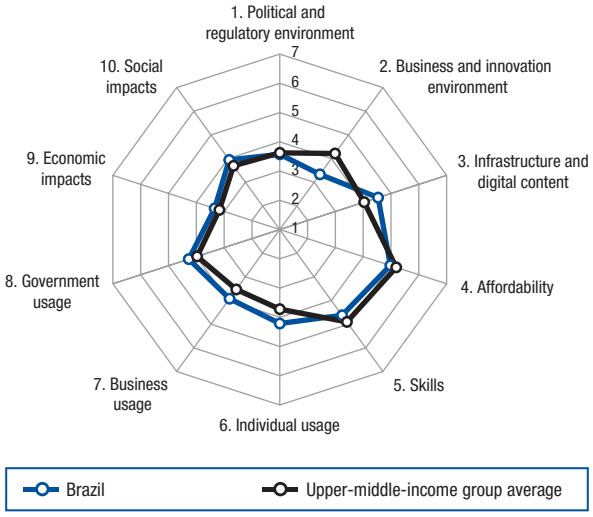
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	17	4.9
1.02	Laws relating to ICTs*	101	3.4
1.03	Judicial independence*	26	5.3
1.04	Efficiency of legal system in settling disputes*	25	4.8
1.05	Efficiency of legal system in challenging regs*	23	4.4
1.06	Intellectual property protection*	47	4.1
1.07	Software piracy rate, % software installed	87	80
1.08	No. procedures to enforce a contract	12	28
1.09	No. days to enforce a contract	100	625
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	91	4.6
2.02	Venture capital availability*	57	2.8
2.03	Total tax rate, % profits	23	25.4
2.04	No. days to start a business	135	60
2.05	No. procedures to start a business	107	9
2.06	Intensity of local competition*	93	4.7
2.07	Tertiary education gross enrollment rate, %	130	7.4
2.08	Quality of management schools*	97	3.8
2.09	Gov't procurement of advanced tech*	67	3.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	124	187.2
3.02	Mobile network coverage, % pop.	97	96.0
3.03	Int'l Internet bandwidth, kb/s per user	104	6.5
3.04	Secure Internet servers/million pop.	89	11.5
3.05	Accessibility of digital content*	103	4.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	125	0.47
4.02	Fixed broadband Internet tariffs, PPP $/month	137	114.48
4.03	Internet & telephony competition, 0–2 (best)	112	1.27
	5th pillar: Skills		
5.01	Quality of educational system*	65	3.7
5.02	Quality of math & science education*	92	3.8
5.03	Secondary education gross enrollment rate, %	92	81.7
5.04	Adult literacy rate, %	102	85.1

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	17	153.8
6.02	Individuals using Internet, %	121	11.5
6.03	Households w/ personal computer, %	109	12.3
6.04	Households w/ Internet access, %	110	9.1
6.05	Fixed broadband Internet subs./100 pop.	108	0.9
6.06	Mobile broadband subscriptions/100 pop.	14	74.9
6.07	Use of virtual social networks*	88	5.4
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	101	4.3
7.02	Capacity for innovation*	102	3.2
7.03	PCT patents, applications/million pop.	94	0.2
7.04	Business-to-business Internet use*	119	4.2
7.05	Business-to-consumer Internet use*	122	3.5
7.06	Extent of staff training*	87	3.8
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	61	4.1
8.02	Government Online Service Index, 0–1 (best)	101	0.36
8.03	Gov't success in ICT promotion*	84	4.1
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	120	3.6
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	126	3.4
9.04	Knowledge-intensive jobs, % workforce	86	17.1
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	93	3.8
10.02	Internet access in schools*	104	3.4
10.03	ICT use & gov't efficiency*	78	4.1
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Brazil

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**69**	**4.0**
Networked Readiness Index 2013 (out of 144)	60	4.0
A. Environment subindex	**116**	**3.4**
1st pillar: Political and regulatory environment	78	3.6
2nd pillar: Business and innovation environment	135	3.3
B. Readiness subindex	**76**	**4.7**
3rd pillar: Infrastructure and digital content	56	4.5
4th pillar: Affordability	91	5.0
5th pillar: Skills	91	4.6
C. Usage subindex	**47**	**4.1**
6th pillar: Individual usage	59	4.2
7th pillar: Business usage	41	3.9
8th pillar: Government usage	54	4.3
D. Impact subindex	**57**	**3.6**
9th pillar: Economic impacts	64	3.3
10th pillar: Social impacts	58	3.9



The Networked Readiness Index in detail

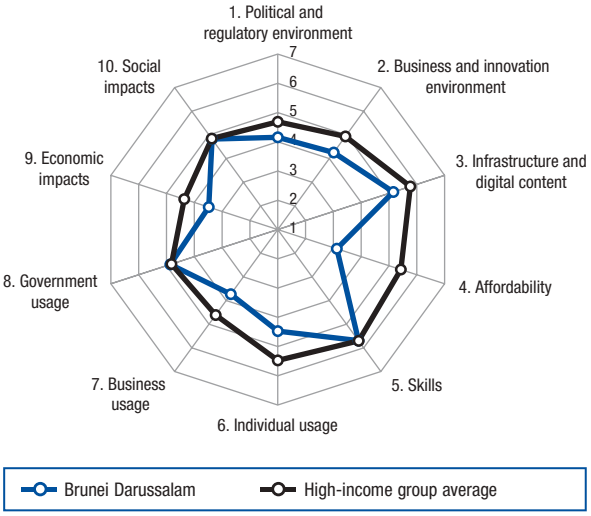
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	133	2.6
1.02	Laws relating to ICTs*	60	4.2
1.03	Judicial independence*	65	3.9
1.04	Efficiency of legal system in settling disputes*	101	3.3
1.05	Efficiency of legal system in challenging regs*	68	3.5
1.06	Intellectual property protection*	80	3.5
1.07	Software piracy rate, % software installed	40	53
1.08	No. procedures to enforce a contract	126	44
1.09	No. days to enforce a contract	114	731
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	63	5.1
2.02	Venture capital availability*	61	2.7
2.03	Total tax rate, % profits	141	68.3
2.04	No. days to start a business	146	108
2.05	No. procedures to start a business	137	13
2.06	Intensity of local competition*	70	5.0
2.07	Tertiary education gross enrollment rate, %	86	25.6
2.08	Quality of management schools*	49	4.5
2.09	Gov't procurement of advanced tech*	69	3.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	73	2700.2
3.02	Mobile network coverage, % pop.	28	100.0
3.03	Int'l Internet bandwidth, kb/s per user	41	44.8
3.04	Secure Internet servers/million pop.	59	54.3
3.05	Accessibility of digital content*	92	4.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	140	0.65
4.02	Fixed broadband Internet tariffs, PPP $/month	14	15.77
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	121	3.0
5.02	Quality of math & science education*	136	2.6
5.03	Secondary education gross enrollment rate, %	20	105.8
5.04	Adult literacy rate, %	85	90.4

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	43	125.0
6.02	Individuals using Internet, %	65	49.8
6.03	Households w/ personal computer, %	65	49.9
6.04	Households w/ Internet access, %	62	45.4
6.05	Fixed broadband Internet subs./100 pop.	65	9.2
6.06	Mobile broadband subscriptions/100 pop.	49	33.7
6.07	Use of virtual social networks*	37	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	51	5.0
7.02	Capacity for innovation*	36	4.0
7.03	PCT patents, applications/million pop.	53	3.0
7.04	Business-to-business Internet use*	54	5.1
7.05	Business-to-consumer Internet use*	30	5.2
7.06	Extent of staff training*	44	4.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	93	3.7
8.02	Government Online Service Index, 0–1 (best)	32	0.67
8.03	Gov't success in ICT promotion*	88	4.1
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	51	4.7
9.02	ICT PCT patents, applications/million pop.	58	0.4
9.03	Impact of ICTs on new organizational models*	43	4.5
9.04	Knowledge-intensive jobs, % workforce	75	20.5
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	88	3.9
10.02	Internet access in schools*	98	3.6
10.03	ICT use & gov't efficiency*	61	4.2
10.04	E-Participation Index, 0–1 (best)	31	0.50

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Brunei Darussalam

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**45**	**4.3**
Networked Readiness Index 2013 (out of 144)	57	4.1
A. Environment subindex	**54**	**4.2**
1st pillar: Political and regulatory environment	46	4.2
2nd pillar: Business and innovation environment	69	4.2
B. Readiness subindex	**78**	**4.7**
3rd pillar: Infrastructure and digital content	37	5.2
4th pillar: Affordability	129	3.1
5th pillar: Skills	30	5.7
C. Usage subindex	**41**	**4.4**
6th pillar: Individual usage	50	4.5
7th pillar: Business usage	56	3.7
8th pillar: Government usage	30	4.9
D. Impact subindex	**38**	**4.2**
9th pillar: Economic impacts	51	3.5
10th pillar: Social impacts	32	4.8



The Networked Readiness Index in detail

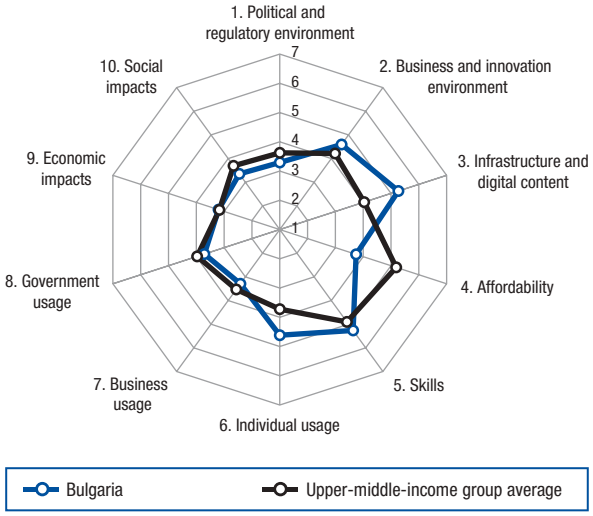
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	26	4.5
1.02	Laws relating to ICTs*	49	4.3
1.03	Judicial independence*	34	5.0
1.04	Efficiency of legal system in settling disputes*	19	5.0
1.05	Efficiency of legal system in challenging regs*	80	3.3
1.06	Intellectual property protection*	39	4.4
1.07	Software piracy rate, % software installed	65	67
1.08	No. procedures to enforce a contract	138	47
1.09	No. days to enforce a contract	73	540
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	50	5.2
2.02	Venture capital availability*	24	3.4
2.03	Total tax rate, % profits	10	16.1
2.04	No. days to start a business	144	101
2.05	No. procedures to start a business	144	15
2.06	Intensity of local competition*	62	5.1
2.07	Tertiary education gross enrollment rate, %	90	24.3
2.08	Quality of management schools*	52	4.5
2.09	Gov't procurement of advanced tech*	10	4.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	16	9163.3
3.02	Mobile network coverage, % pop.	n/a	n/a
3.03	Int'l Internet bandwidth, kb/s per user	48	39.9
3.04	Secure Internet servers/million pop.	50	111.6
3.05	Accessibility of digital content*	48	5.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	111	0.38
4.02	Fixed broadband Internet tariffs, PPP $/month	122	66.38
4.03	Internet & telephony competition, 0–2 (best)	134	0.88
	5th pillar: Skills		
5.01	Quality of educational system*	32	4.4
5.02	Quality of math & science education*	29	4.8
5.03	Secondary education gross enrollment rate, %	15	107.8
5.04	Adult literacy rate, %	62	95.4

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	62	114.0
6.02	Individuals using Internet, %	48	60.3
6.03	Households w/ personal computer, %	14	86.9
6.04	Households w/ Internet access, %	30	72.4
6.05	Fixed broadband Internet subs./100 pop.	81	4.8
6.06	Mobile broadband subscriptions/100 pop.	94	7.6
6.07	Use of virtual social networks*	19	6.3
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	63	4.8
7.02	Capacity for innovation*	67	3.5
7.03	PCT patents, applications/million pop.	58	1.8
7.04	Business-to-business Internet use*	59	5.0
7.05	Business-to-consumer Internet use*	75	4.5
7.06	Extent of staff training*	26	4.6
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	17	5.0
8.02	Government Online Service Index, 0–1 (best)	44	0.59
8.03	Gov't success in ICT promotion*	21	5.0
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	66	4.5
9.02	ICT PCT patents, applications/million pop.	41	1.2
9.03	Impact of ICTs on new organizational models*	54	4.4
9.04	Knowledge-intensive jobs, % workforce	51	28.4
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	30	5.2
10.02	Internet access in schools*	32	5.5
10.03	ICT use & gov't efficiency*	39	4.8
10.04	E-Participation Index, 0–1 (best)	34	0.47

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Bulgaria

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**73**	**4.0**
Networked Readiness Index 2013 (out of 144)	71	3.9
A. Environment subindex	**71**	**3.9**
1st pillar: Political and regulatory environment	105	3.3
2nd pillar: Business and innovation environment	50	4.6
B. Readiness subindex	**75**	**4.8**
3rd pillar: Infrastructure and digital content	34	5.3
4th pillar: Affordability	119	3.7
5th pillar: Skills	56	5.3
C. Usage subindex	**65**	**3.9**
6th pillar: Individual usage	47	4.6
7th pillar: Business usage	104	3.3
8th pillar: Government usage	97	3.7
D. Impact subindex	**86**	**3.3**
9th pillar: Economic impacts	73	3.2
10th pillar: Social impacts	93	3.4



The Networked Readiness Index in detail

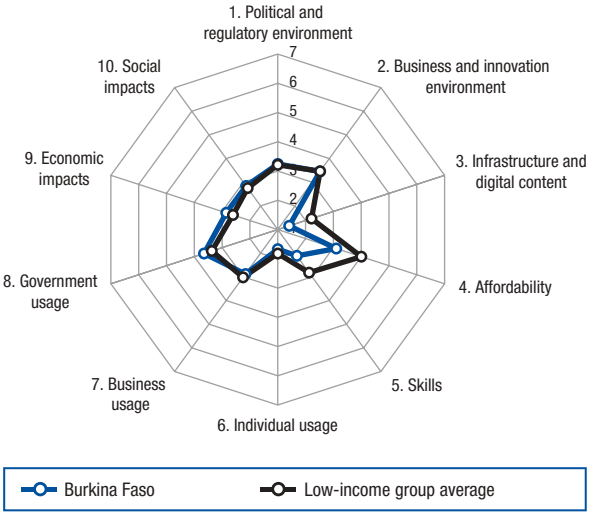
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	117	2.8
1.02	Laws relating to ICTs*	66	4.0
1.03	Judicial independence*	123	2.6
1.04	Efficiency of legal system in settling disputes*	125	2.9
1.05	Efficiency of legal system in challenging regs*	122	2.8
1.06	Intellectual property protection*	104	3.0
1.07	Software piracy rate, % software installed	61	64
1.08	No. procedures to enforce a contract	78	38
1.09	No. days to enforce a contract	77	564
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	99	4.4
2.02	Venture capital availability*	65	2.7
2.03	Total tax rate, % profits	31	27.7
2.04	No. days to start a business	86	18
2.05	No. procedures to start a business	22	4
2.06	Intensity of local competition*	101	4.6
2.07	Tertiary education gross enrollment rate, %	41	59.6
2.08	Quality of management schools*	112	3.6
2.09	Gov't procurement of advanced tech*	90	3.3
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	32	6807.4
3.02	Mobile network coverage, % pop.	28	100.0
3.03	Int'l Internet bandwidth, kb/s per user	25	85.4
3.04	Secure Internet servers/million pop.	43	164.1
3.05	Accessibility of digital content*	65	5.2
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	142	0.82
4.02	Fixed broadband Internet tariffs, PPP $/month	33	22.36
4.03	Internet & telephony competition, 0–2 (best)	104	1.33
	5th pillar: Skills		
5.01	Quality of educational system*	90	3.4
5.02	Quality of math & science education*	59	4.3
5.03	Secondary education gross enrollment rate, %	61	93.2
5.04	Adult literacy rate, %	46	98.4

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	21	148.1
6.02	Individuals using Internet, %	55	55.1
6.03	Households w/ personal computer, %	61	52.0
6.04	Households w/ Internet access, %	55	51.0
6.05	Fixed broadband Internet subs./100 pop.	38	17.9
6.06	Mobile broadband subscriptions/100 pop.	34	48.5
6.07	Use of virtual social networks*	79	5.6
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	113	4.2
7.02	Capacity for innovation*	103	3.2
7.03	PCT patents, applications/million pop.	48	4.8
7.04	Business-to-business Internet use*	78	4.8
7.05	Business-to-consumer Internet use*	64	4.7
7.06	Extent of staff training*	127	3.2
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	110	3.4
8.02	Government Online Service Index, 0–1 (best)	70	0.49
8.03	Gov't success in ICT promotion*	111	3.8
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	104	3.9
9.02	ICT PCT patents, applications/million pop.	43	1.1
9.03	Impact of ICTs on new organizational models*	102	3.7
9.04	Knowledge-intensive jobs, % workforce	49	29.6
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	91	3.8
10.02	Internet access in schools*	51	4.7
10.03	ICT use & gov't efficiency*	100	3.7
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Burkina Faso

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**136**	**2.8**
Networked Readiness Index 2013 (out of 144)	130	2.8
A. Environment subindex	**126**	**3.3**
1st pillar: Political and regulatory environment	108	3.2
2nd pillar: Business and innovation environment	128	3.5
B. Readiness subindex	**147**	**2.2**
3rd pillar: Infrastructure and digital content	147	1.4
4th pillar: Affordability	131	3.1
5th pillar: Skills	144	2.1
C. Usage subindex	**127**	**2.7**
6th pillar: Individual usage	139	1.7
7th pillar: Business usage	135	2.9
8th pillar: Government usage	101	3.7
D. Impact subindex	**118**	**2.8**
9th pillar: Economic impacts	108	2.9
10th pillar: Social impacts	120	2.8



The Networked Readiness Index in detail

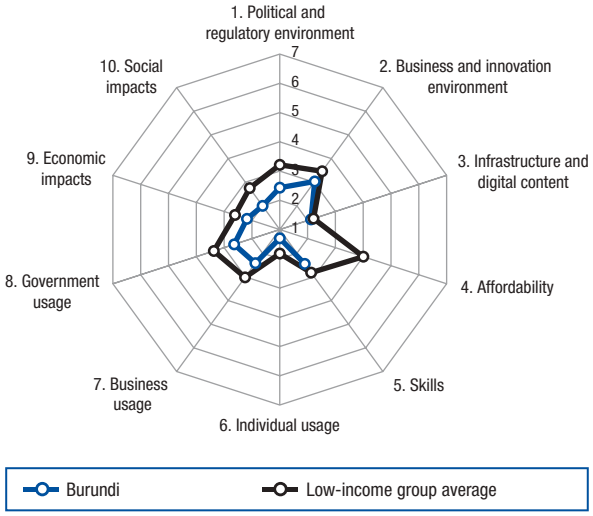
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	116	2.9
1.02	Laws relating to ICTs*	124	3.0
1.03	Judicial independence*	142	2.1
1.04	Efficiency of legal system in settling disputes*	103	3.3
1.05	Efficiency of legal system in challenging regs*	106	3.0
1.06	Intellectual property protection*	88	3.4
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	67	37
1.09	No. days to enforce a contract	47	446
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	145	3.2
2.02	Venture capital availability*	147	1.7
2.03	Total tax rate, % profits	99	43.9
2.04	No. days to start a business	68	13
2.05	No. procedures to start a business	10	3
2.06	Intensity of local competition*	116	4.4
2.07	Tertiary education gross enrollment rate, %	138	4.6
2.08	Quality of management schools*	110	3.6
2.09	Gov't procurement of advanced tech*	94	3.2
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	142	44.0
3.02	Mobile network coverage, % pop.	137	61.1
3.03	Int'l Internet bandwidth, kb/s per user	139	1.8
3.04	Secure Internet servers/million pop.	139	0.6
3.05	Accessibility of digital content*	147	2.6
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	100	0.34
4.02	Fixed broadband Internet tariffs, PPP $/month	131	101.12
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	127	2.7
5.02	Quality of math & science education*	97	3.7
5.03	Secondary education gross enrollment rate, %	145	25.9
5.04	Adult literacy rate, %	147	28.7

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	129	60.6
6.02	Individuals using Internet, %	138	3.7
6.03	Households w/ personal computer, %	135	3.4
6.04	Households w/ Internet access, %	134	2.8
6.05	Fixed broadband Internet subs./100 pop.	129	0.1
6.06	Mobile broadband subscriptions/100 pop.	139	0.0
6.07	Use of virtual social networks*	142	4.2
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	140	3.7
7.02	Capacity for innovation*	119	3.0
7.03	PCT patents, applications/million pop.	110	0.0
7.04	Business-to-business Internet use*	117	4.3
7.05	Business-to-consumer Internet use*	129	3.4
7.06	Extent of staff training*	142	2.9
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	68	4.0
8.02	Government Online Service Index, 0–1 (best)	120	0.29
8.03	Gov't success in ICT promotion*	80	4.2
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	89	4.1
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	120	3.5
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	105	3.6
10.02	Internet access in schools*	147	1.6
10.03	ICT use & gov't efficiency*	69	4.1
10.04	E-Participation Index, 0–1 (best)	77	0.16

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Burundi

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**147**	**2.3**
Networked Readiness Index 2013 (out of 144)	144	2.3
A. Environment subindex	**144**	**2.7**
1st pillar: Political and regulatory environment	146	2.4
2nd pillar: Business and innovation environment	142	3.0
B. Readiness subindex	**145**	**2.3**
3rd pillar: Infrastructure and digital content	133	2.1
4th pillar: Affordability	n/a	n/a
5th pillar: Skills	137	2.4
C. Usage subindex	**148**	**2.1**
6th pillar: Individual usage	148	1.3
7th pillar: Business usage	148	2.4
8th pillar: Government usage	144	2.6
D. Impact subindex	**146**	**2.1**
9th pillar: Economic impacts	144	2.2
10th pillar: Social impacts	147	2.0



The Networked Readiness Index in detail

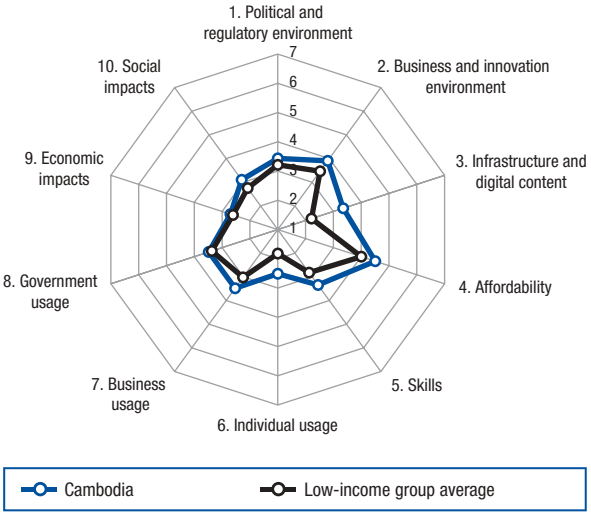
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	136	2.4
1.02	Laws relating to ICTs*	141	2.3
1.03	Judicial independence*	147	1.7
1.04	Efficiency of legal system in settling disputes*	136	2.6
1.05	Efficiency of legal system in challenging regs*	135	2.5
1.06	Intellectual property protection*	142	2.3
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	126	44
1.09	No. days to enforce a contract	121	832
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	143	3.2
2.02	Venture capital availability*	137	1.9
2.03	Total tax rate, % profits	122	51.6
2.04	No. days to start a business	15	5
2.05	No. procedures to start a business	10	3
2.06	Intensity of local competition*	146	3.3
2.07	Tertiary education gross enrollment rate, %	143	3.2
2.08	Quality of management schools*	142	2.6
2.09	Gov't procurement of advanced tech*	138	2.6
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	147	14.2
3.02	Mobile network coverage, % pop.	122	83.0
3.03	Int'l Internet bandwidth, kb/s per user	123	3.5
3.04	Secure Internet servers/million pop.	144	0.3
3.05	Accessibility of digital content*	146	2.6
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	n/a	n/a
4.02	Fixed broadband Internet tariffs, PPP $/month	n/a	n/a
4.03	Internet & telephony competition, 0–2 (best)	96	1.54
	5th pillar: Skills		
5.01	Quality of educational system*	143	2.3
5.02	Quality of math & science education*	103	3.4
5.03	Secondary education gross enrollment rate, %	142	28.5
5.04	Adult literacy rate, %	123	67.2

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	146	22.8
6.02	Individuals using Internet, %	146	1.2
6.03	Households w/ personal computer, %	147	0.1
6.04	Households w/ Internet access, %	146	0.1
6.05	Fixed broadband Internet subs./100 pop.	145	0.0
6.06	Mobile broadband subscriptions/100 pop.	138	0.0
6.07	Use of virtual social networks*	148	3.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	143	3.5
7.02	Capacity for innovation*	148	2.2
7.03	PCT patents, applications/million pop.	122	0.0
7.04	Business-to-business Internet use*	146	3.0
7.05	Business-to-consumer Internet use*	147	2.6
7.06	Extent of staff training*	147	2.6
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	127	3.0
8.02	Government Online Service Index, 0–1 (best)	137	0.15
8.03	Gov't success in ICT promotion*	145	3.0
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	144	2.9
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	147	2.6
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	148	2.6
10.02	Internet access in schools*	144	1.8
10.03	ICT use & gov't efficiency*	146	2.6
10.04	E-Participation Index, 0–1 (best)	127	0.00

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Cambodia

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**108**	**3.4**
Networked Readiness Index 2013 (out of 144)	106	3.3
A. Environment subindex	**98**	**3.7**
1st pillar: Political and regulatory environment	95	3.4
2nd pillar: Business and innovation environment	98	3.9
B. Readiness subindex	**113**	**3.7**
3rd pillar: Infrastructure and digital content	97	3.3
4th pillar: Affordability	105	4.5
5th pillar: Skills	119	3.3
C. Usage subindex	**107**	**3.2**
6th pillar: Individual usage	105	2.5
7th pillar: Business usage	78	3.5
8th pillar: Government usage	114	3.5
D. Impact subindex	**111**	**2.9**
9th pillar: Economic impacts	117	2.7
10th pillar: Social impacts	110	3.1



The Networked Readiness Index in detail

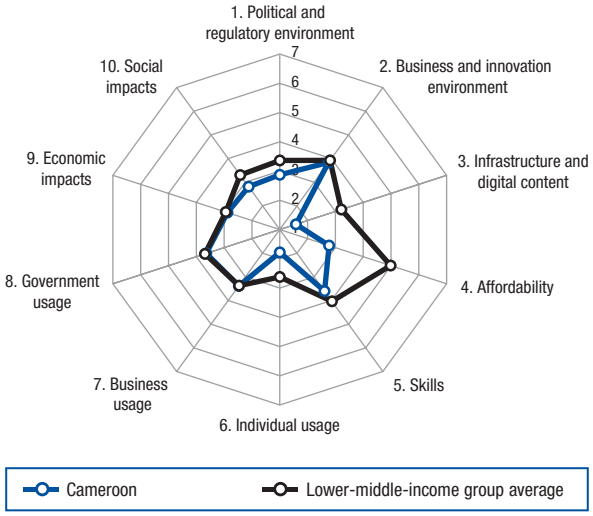
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	67	3.6
1.02	Laws relating to ICTs*	98	3.5
1.03	Judicial independence*	115	2.8
1.04	Efficiency of legal system in settling disputes*	83	3.5
1.05	Efficiency of legal system in challenging regs*	72	3.5
1.06	Intellectual property protection*	99	3.2
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	126	44
1.09	No. days to enforce a contract	54	483
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	82	4.7
2.02	Venture capital availability*	43	3.0
2.03	Total tax rate, % profits	15	21.4
2.04	No. days to start a business	145	104
2.05	No. procedures to start a business	129	11
2.06	Intensity of local competition*	78	4.9
2.07	Tertiary education gross enrollment rate, %	104	15.8
2.08	Quality of management schools*	108	3.7
2.09	Gov't procurement of advanced tech*	46	3.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	138	72.1
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	89	13.6
3.04	Secure Internet servers/million pop.	113	3.0
3.05	Accessibility of digital content*	86	4.8
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	55	0.19
4.02	Fixed broadband Internet tariffs, PPP $/month	116	61.54
4.03	Internet & telephony competition, 0–2 (best)	65	1.88
	5th pillar: Skills		
5.01	Quality of educational system*	76	3.6
5.02	Quality of math & science education*	102	3.5
5.03	Secondary education gross enrollment rate, %	128	45.0
5.04	Adult literacy rate, %	112	73.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	36	128.5
6.02	Individuals using Internet, %	131	4.9
6.03	Households w/ personal computer, %	128	5.4
6.04	Households w/ Internet access, %	127	3.9
6.05	Fixed broadband Internet subs./100 pop.	121	0.2
6.06	Mobile broadband subscriptions/100 pop.	97	6.7
6.07	Use of virtual social networks*	108	5.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	82	4.6
7.02	Capacity for innovation*	71	3.5
7.03	PCT patents, applications/million pop.	122	0.0
7.04	Business-to-business Internet use*	82	4.7
7.05	Business-to-consumer Internet use*	107	3.9
7.06	Extent of staff training*	66	4.0
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	85	3.8
8.02	Government Online Service Index, 0–1 (best)	131	0.19
8.03	Gov't success in ICT promotion*	52	4.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	77	4.3
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	62	4.3
9.04	Knowledge-intensive jobs, % workforce	118	2.5
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	87	3.9
10.02	Internet access in schools*	89	3.8
10.03	ICT use & gov't efficiency*	99	3.7
10.04	E-Participation Index, 0–1 (best)	127	0.00

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Cameroon

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**131**	**2.9**
Networked Readiness Index 2013 (out of 144)	124	2.9
A. Environment subindex	**125**	**3.3**
1st pillar: Political and regulatory environment	132	2.9
2nd pillar: Business and innovation environment	111	3.8
B. Readiness subindex	**137**	**2.6**
3rd pillar: Infrastructure and digital content	143	1.6
4th pillar: Affordability	136	2.8
5th pillar: Skills	116	3.6
C. Usage subindex	**119**	**2.9**
6th pillar: Individual usage	130	1.8
7th pillar: Business usage	95	3.4
8th pillar: Government usage	102	3.6
D. Impact subindex	**116**	**2.8**
9th pillar: Economic impacts	103	2.9
10th pillar: Social impacts	123	2.8



The Networked Readiness Index in detail

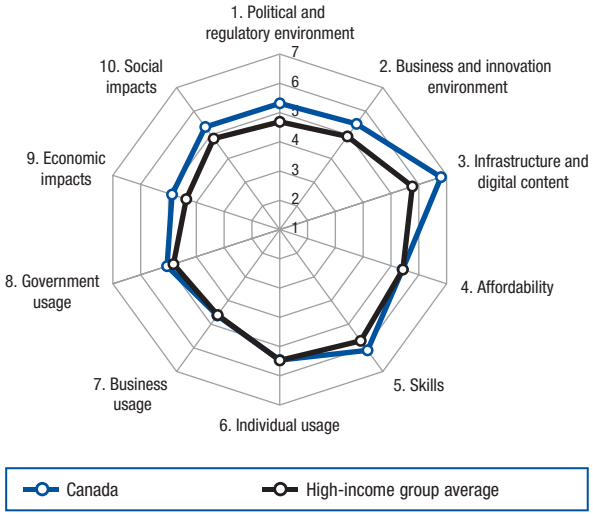
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	113	2.9
1.02	Laws relating to ICTs*	128	2.9
1.03	Judicial independence*	136	2.3
1.04	Efficiency of legal system in settling disputes*	102	3.3
1.05	Efficiency of legal system in challenging regs*	103	3.0
1.06	Intellectual property protection*	100	3.2
1.07	Software piracy rate, % software installed	93	83
1.08	No. procedures to enforce a contract	116	42
1.09	No. days to enforce a contract	120	800
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	111	4.2
2.02	Venture capital availability*	112	2.2
2.03	Total tax rate, % profits	112	48.8
2.04	No. days to start a business	76	15
2.05	No. procedures to start a business	34	5
2.06	Intensity of local competition*	92	4.7
2.07	Tertiary education gross enrollment rate, %	115	11.9
2.08	Quality of management schools*	48	4.6
2.09	Gov't procurement of advanced tech*	38	3.9
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	119	283.4
3.02	Mobile network coverage, % pop.	138	58.0
3.03	Int'l Internet bandwidth, kb/s per user	146	0.3
3.04	Secure Internet servers/million pop.	130	1.2
3.05	Accessibility of digital content*	129	3.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	103	0.35
4.02	Fixed broadband Internet tariffs, PPP $/month	135	112.53
4.03	Internet & telephony competition, 0–2 (best)	116	1.22
	5th pillar: Skills		
5.01	Quality of educational system*	60	3.9
5.02	Quality of math & science education*	72	4.1
5.03	Secondary education gross enrollment rate, %	121	50.4
5.04	Adult literacy rate, %	118	71.3

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	130	60.4
6.02	Individuals using Internet, %	129	5.7
6.03	Households w/ personal computer, %	119	8.3
6.04	Households w/ Internet access, %	129	3.5
6.05	Fixed broadband Internet subs./100 pop.	113	0.6
6.06	Mobile broadband subscriptions/100 pop.	137	0.0
6.07	Use of virtual social networks*	121	4.8
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	94	4.4
7.02	Capacity for innovation*	105	3.1
7.03	PCT patents, applications/million pop.	104	0.1
7.04	Business-to-business Internet use*	68	4.8
7.05	Business-to-consumer Internet use*	104	4.0
7.06	Extent of staff training*	78	3.9
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	82	3.8
8.02	Government Online Service Index, 0–1 (best)	116	0.30
8.03	Gov't success in ICT promotion*	72	4.3
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	97	4.0
9.02	ICT PCT patents, applications/million pop.	87	0.0
9.03	Impact of ICTs on new organizational models*	108	3.6
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	100	3.7
10.02	Internet access in schools*	135	2.3
10.03	ICT use & gov't efficiency*	77	4.1
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Canada

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**17**	**5.4**
Networked Readiness Index 2013 (out of 144)	12	5.4
A. Environment subindex	**10**	**5.4**
1st pillar: Political and regulatory environment	12	5.3
2nd pillar: Business and innovation environment	3	5.5
B. Readiness subindex	**13**	**6.1**
3rd pillar: Infrastructure and digital content	7	6.8
4th pillar: Affordability	65	5.4
5th pillar: Skills	8	6.1
C. Usage subindex	**26**	**5.0**
6th pillar: Individual usage	27	5.5
7th pillar: Business usage	25	4.6
8th pillar: Government usage	25	5.0
D. Impact subindex	**17**	**5.1**
9th pillar: Economic impacts	17	4.9
10th pillar: Social impacts	16	5.3



The Networked Readiness Index in detail

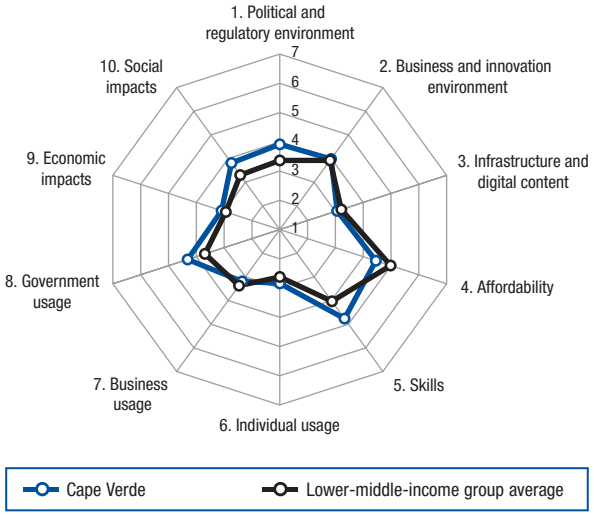
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	10	5.2
1.02	Laws relating to ICTs*	19	5.1
1.03	Judicial independence*	10	6.2
1.04	Efficiency of legal system in settling disputes*	11	5.4
1.05	Efficiency of legal system in challenging regs*	15	4.8
1.06	Intellectual property protection*	13	5.6
1.07	Software piracy rate, % software installed	14	27
1.08	No. procedures to enforce a contract	55	36
1.09	No. days to enforce a contract	80	570
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	19	6.1
2.02	Venture capital availability*	23	3.4
2.03	Total tax rate, % profits	21	24.3
2.04	No. days to start a business	15	5
2.05	No. procedures to start a business	1	1
2.06	Intensity of local competition*	33	5.4
2.07	Tertiary education gross enrollment rate, %	43	58.9
2.08	Quality of management schools*	7	5.7
2.09	Gov't procurement of advanced tech*	55	3.6
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	3	18510.4
3.02	Mobile network coverage, % pop.	58	99.0
3.03	Int'l Internet bandwidth, kb/s per user	18	100.5
3.04	Secure Internet servers/million pop.	15	1233.4
3.05	Accessibility of digital content*	21	6.1
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	93	0.33
4.02	Fixed broadband Internet tariffs, PPP $/month	75	32.57
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	10	5.2
5.02	Quality of math & science education*	17	5.2
5.03	Secondary education gross enrollment rate, %	26	102.3
5.04	Adult literacy rate, %	14	99.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	116	80.1
6.02	Individuals using Internet, %	12	86.8
6.03	Households w/ personal computer, %	15	86.6
6.04	Households w/ Internet access, %	16	83.0
6.05	Fixed broadband Internet subs./100 pop.	11	32.5
6.06	Mobile broadband subscriptions/100 pop.	39	42.1
6.07	Use of virtual social networks*	13	6.3
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	34	5.4
7.02	Capacity for innovation*	27	4.3
7.03	PCT patents, applications/million pop.	19	82.4
7.04	Business-to-business Internet use*	31	5.5
7.05	Business-to-consumer Internet use*	21	5.5
7.06	Extent of staff training*	34	4.5
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	56	4.2
8.02	Government Online Service Index, 0–1 (best)	6	0.89
8.03	Gov't success in ICT promotion*	51	4.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	28	5.1
9.02	ICT PCT patents, applications/million pop.	12	31.4
9.03	Impact of ICTs on new organizational models*	13	5.1
9.04	Knowledge-intensive jobs, % workforce	13	43.8
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	26	5.2
10.02	Internet access in schools*	11	6.1
10.03	ICT use & gov't efficiency*	32	4.8
10.04	E-Participation Index, 0–1 (best)	15	0.68

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Cape Verde

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**89**	**3.7**
Networked Readiness Index 2013 (out of 144)	81	3.8
A. Environment subindex	**69**	**3.9**
1st pillar: Political and regulatory environment	58	3.9
2nd pillar: Business and innovation environment	93	4.0
B. Readiness subindex	**102**	**4.1**
3rd pillar: Infrastructure and digital content	107	3.1
4th pillar: Affordability	106	4.5
5th pillar: Skills	82	4.8
C. Usage subindex	**92**	**3.4**
6th pillar: Individual usage	97	2.8
7th pillar: Business usage	115	3.2
8th pillar: Government usage	50	4.3
D. Impact subindex	**73**	**3.5**
9th pillar: Economic impacts	83	3.1
10th pillar: Social impacts	69	3.8



The Networked Readiness Index in detail

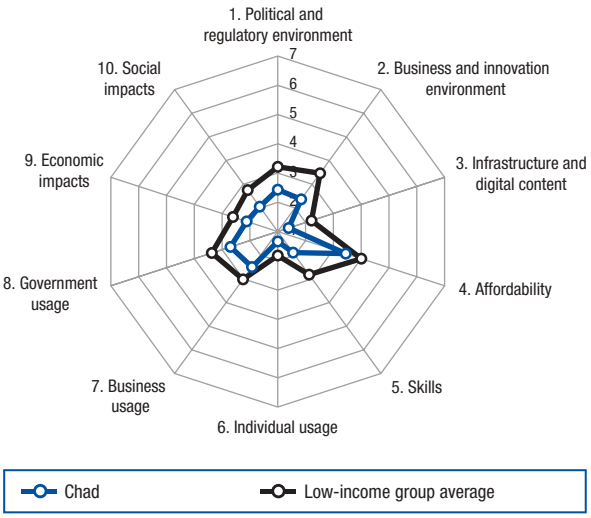
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	44	4.1
1.02	Laws relating to ICTs*	82	3.8
1.03	Judicial independence*	53	4.1
1.04	Efficiency of legal system in settling disputes*	72	3.7
1.05	Efficiency of legal system in challenging regs*	64	3.5
1.06	Intellectual property protection*	105	3.0
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	67	37
1.09	No. days to enforce a contract	39	425
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	78	4.8
2.02	Venture capital availability*	100	2.3
2.03	Total tax rate, % profits	74	37.2
2.04	No. days to start a business	53	10
2.05	No. procedures to start a business	79	7
2.06	Intensity of local competition*	122	4.3
2.07	Tertiary education gross enrollment rate, %	94	20.6
2.08	Quality of management schools*	116	3.5
2.09	Gov't procurement of advanced tech*	41	3.8
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	111	570.3
3.02	Mobile network coverage, % pop.	97	96.0
3.03	Int'l Internet bandwidth, kb/s per user	106	6.3
3.04	Secure Internet servers/million pop.	75	24.3
3.05	Accessibility of digital content*	104	4.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	122	0.46
4.02	Fixed broadband Internet tariffs, PPP $/month	98	40.41
4.03	Internet & telephony competition, 0–2 (best)	77	1.83
	5th pillar: Skills		
5.01	Quality of educational system*	61	3.9
5.02	Quality of math & science education*	100	3.5
5.03	Secondary education gross enrollment rate, %	64	92.7
5.04	Adult literacy rate, %	105	84.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	108	86.0
6.02	Individuals using Internet, %	89	34.7
6.03	Households w/ personal computer, %	87	26.5
6.04	Households w/ Internet access, %	97	13.7
6.05	Fixed broadband Internet subs./100 pop.	86	4.0
6.06	Mobile broadband subscriptions/100 pop.	66	23.0
6.07	Use of virtual social networks*	97	5.3
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	85	4.5
7.02	Capacity for innovation*	126	2.9
7.03	PCT patents, applications/million pop.	122	0.0
7.04	Business-to-business Internet use*	100	4.5
7.05	Business-to-consumer Internet use*	110	3.8
7.06	Extent of staff training*	118	3.4
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	32	4.6
8.02	Government Online Service Index, 0–1 (best)	85	0.44
8.03	Gov't success in ICT promotion*	38	4.7
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	79	4.3
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	84	4.0
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	61	4.4
10.02	Internet access in schools*	91	3.8
10.03	ICT use & gov't efficiency*	42	4.7
10.04	E-Participation Index, 0–1 (best)	59	0.24

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Chad

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**148**	**2.2**
Networked Readiness Index 2013 (out of 144)	142	2.5
A. Environment subindex	**148**	**2.4**
1st pillar: Political and regulatory environment	147	2.4
2nd pillar: Business and innovation environment	148	2.4
B. Readiness subindex	**146**	**2.2**
3rd pillar: Infrastructure and digital content	148	1.4
4th pillar: Affordability	123	3.4
5th pillar: Skills	148	1.9
C. Usage subindex	**147**	**2.2**
6th pillar: Individual usage	147	1.3
7th pillar: Business usage	146	2.5
8th pillar: Government usage	142	2.7
D. Impact subindex	**147**	**2.1**
9th pillar: Economic impacts	146	2.1
10th pillar: Social impacts	146	2.0



The Networked Readiness Index in detail

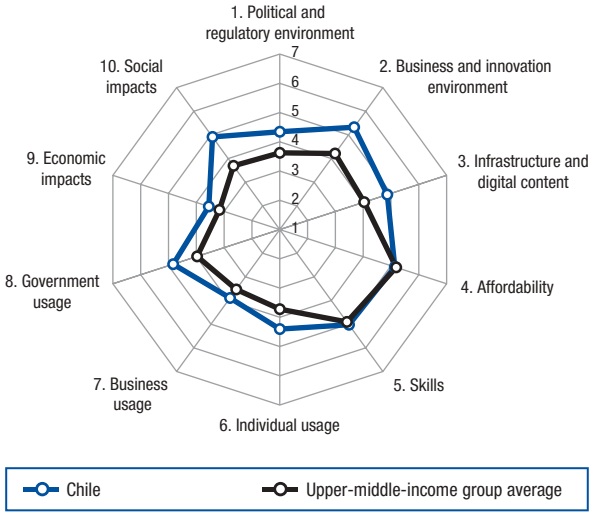
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	142	2.1
1.02	Laws relating to ICTs*	145	2.1
1.03	Judicial independence*	144	2.0
1.04	Efficiency of legal system in settling disputes*	142	2.4
1.05	Efficiency of legal system in challenging regs*	145	2.2
1.06	Intellectual property protection*	144	2.2
1.07	Software piracy rate, % software installed	n/a	n/a
1.08	No. procedures to enforce a contract	111	41
1.09	No. days to enforce a contract	116	743
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	147	2.9
2.02	Venture capital availability*	143	1.7
2.03	Total tax rate, % profits	143	73.8
2.04	No. days to start a business	136	62
2.05	No. procedures to start a business	107	9
2.06	Intensity of local competition*	145	3.3
2.07	Tertiary education gross enrollment rate, %	145	2.3
2.08	Quality of management schools*	140	2.7
2.09	Gov't procurement of advanced tech*	126	2.8
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	148	8.4
3.02	Mobile network coverage, % pop.	140	36.1
3.03	Int'l Internet bandwidth, kb/s per user	144	0.5
3.04	Secure Internet servers/million pop.	n/a	n/a
3.05	Accessibility of digital content*	148	2.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	143	0.88
4.02	Fixed broadband Internet tariffs, PPP $/month	52	26.28
4.03	Internet & telephony competition, 0–2 (best)	98	1.50
	5th pillar: Skills		
5.01	Quality of educational system*	131	2.7
5.02	Quality of math & science education*	127	2.9
5.03	Secondary education gross enrollment rate, %	147	22.8
5.04	Adult literacy rate, %	145	35.4

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	144	35.4
6.02	Individuals using Internet, %	141	2.1
6.03	Households w/ personal computer, %	139	2.5
6.04	Households w/ Internet access, %	140	2.3
6.05	Fixed broadband Internet subs./100 pop.	123	0.2
6.06	Mobile broadband subscriptions/100 pop.	140	0.0
6.07	Use of virtual social networks*	146	3.4
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	144	3.4
7.02	Capacity for innovation*	139	2.6
7.03	PCT patents, applications/million pop.	122	0.0
7.04	Business-to-business Internet use*	148	2.9
7.05	Business-to-consumer Internet use*	148	2.5
7.06	Extent of staff training*	145	2.8
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	121	3.2
8.02	Government Online Service Index, 0–1 (best)	141	0.10
8.03	Gov't success in ICT promotion*	130	3.3
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	147	2.8
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	148	2.6
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	146	2.6
10.02	Internet access in schools*	148	1.3
10.03	ICT use & gov't efficiency*	131	3.0
10.04	E-Participation Index, 0–1 (best)	112	0.03

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Chile

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**35**	**4.6**
Networked Readiness Index 2013 (out of 144)	34	4.6
A. Environment subindex	**29**	**4.8**
1st pillar: Political and regulatory environment	38	4.3
2nd pillar: Business and innovation environment	11	5.3
B. Readiness subindex	**60**	**5.0**
3rd pillar: Infrastructure and digital content	44	4.9
4th pillar: Affordability	81	5.1
5th pillar: Skills	71	5.0
C. Usage subindex	**39**	**4.4**
6th pillar: Individual usage	52	4.4
7th pillar: Business usage	45	3.9
8th pillar: Government usage	32	4.8
D. Impact subindex	**37**	**4.2**
9th pillar: Economic impacts	43	3.5
10th pillar: Social impacts	29	4.9



The Networked Readiness Index in detail

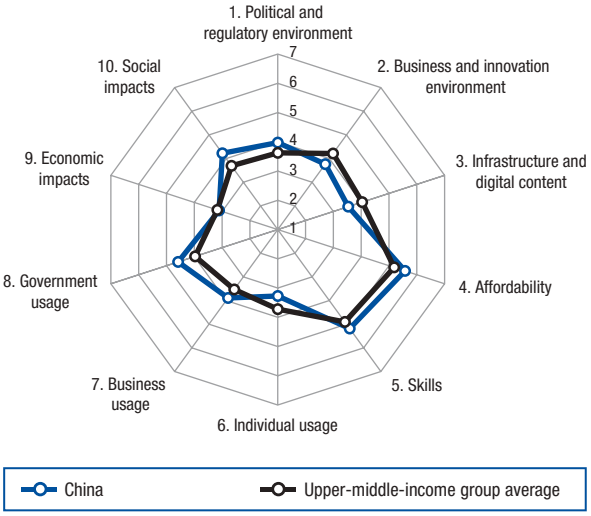
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	62	3.7
1.02	Laws relating to ICTs*	36	4.8
1.03	Judicial independence*	27	5.3
1.04	Efficiency of legal system in settling disputes*	29	4.7
1.05	Efficiency of legal system in challenging regs*	24	4.4
1.06	Intellectual property protection*	60	3.8
1.07	Software piracy rate, % software installed	53	61
1.08	No. procedures to enforce a contract	55	36
1.09	No. days to enforce a contract	53	480
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	34	5.8
2.02	Venture capital availability*	31	3.3
2.03	Total tax rate, % profits	31	27.7
2.04	No. days to start a business	19	6
2.05	No. procedures to start a business	79	7
2.06	Intensity of local competition*	37	5.4
2.07	Tertiary education gross enrollment rate, %	26	70.5
2.08	Quality of management schools*	16	5.3
2.09	Gov't procurement of advanced tech*	27	4.0
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	58	3915.6
3.02	Mobile network coverage, % pop.	1	100.0
3.03	Int'l Internet bandwidth, kb/s per user	46	40.5
3.04	Secure Internet servers/million pop.	54	82.2
3.05	Accessibility of digital content*	46	5.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	98	0.34
4.02	Fixed broadband Internet tariffs, PPP $/month	90	37.16
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	74	3.6
5.02	Quality of math & science education*	107	3.4
5.03	Secondary education gross enrollment rate, %	74	89.9
5.04	Adult literacy rate, %	43	98.6

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	29	138.2
6.02	Individuals using Internet, %	45	61.4
6.03	Households w/ personal computer, %	60	53.7
6.04	Households w/ Internet access, %	63	45.3
6.05	Fixed broadband Internet subs./100 pop.	52	12.4
6.06	Mobile broadband subscriptions/100 pop.	58	28.0
6.07	Use of virtual social networks*	26	6.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	45	5.1
7.02	Capacity for innovation*	63	3.5
7.03	PCT patents, applications/million pop.	41	6.3
7.04	Business-to-business Internet use*	35	5.5
7.05	Business-to-consumer Internet use*	35	5.1
7.06	Extent of staff training*	46	4.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	40	4.4
8.02	Government Online Service Index, 0–1 (best)	24	0.75
8.03	Gov't success in ICT promotion*	54	4.5
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	29	5.0
9.02	ICT PCT patents, applications/million pop.	51	0.5
9.03	Impact of ICTs on new organizational models*	38	4.7
9.04	Knowledge-intensive jobs, % workforce	63	24.1
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	38	5.0
10.02	Internet access in schools*	48	4.9
10.03	ICT use & gov't efficiency*	28	4.9
10.04	E-Participation Index, 0–1 (best)	19	0.66

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

China

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**62**	**4.1**
Networked Readiness Index 2013 (out of 144)	58	4.0
A. Environment subindex	**77**	**3.9**
1st pillar: Political and regulatory environment	56	4.0
2nd pillar: Business and innovation environment	115	3.8
B. Readiness subindex	**73**	**4.8**
3rd pillar: Infrastructure and digital content	86	3.5
4th pillar: Affordability	60	5.6
5th pillar: Skills	59	5.2
C. Usage subindex	**61**	**3.9**
6th pillar: Individual usage	80	3.3
7th pillar: Business usage	44	3.9
8th pillar: Government usage	38	4.6
D. Impact subindex	**56**	**3.7**
9th pillar: Economic impacts	81	3.1
10th pillar: Social impacts	44	4.2



The Networked Readiness Index in detail

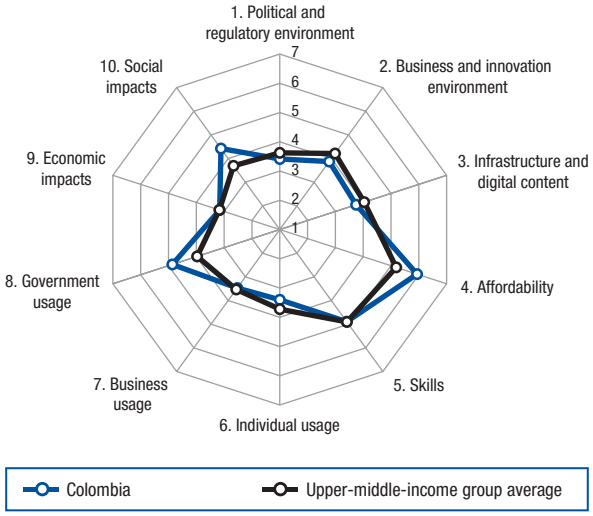
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	39	4.2
1.02	Laws relating to ICTs*	52	4.3
1.03	Judicial independence*	57	4.0
1.04	Efficiency of legal system in settling disputes*	43	4.2
1.05	Efficiency of legal system in challenging regs*	47	3.8
1.06	Intellectual property protection*	53	3.9
1.07	Software piracy rate, % software installed	80	77
1.08	No. procedures to enforce a contract	67	37
1.09	No. days to enforce a contract	32	406
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	105	4.4
2.02	Venture capital availability*	16	3.8
2.03	Total tax rate, % profits	135	63.7
2.04	No. days to start a business	118	33
2.05	No. procedures to start a business	137	13
2.06	Intensity of local competition*	46	5.3
2.07	Tertiary education gross enrollment rate, %	91	24.3
2.08	Quality of management schools*	83	4.1
2.09	Gov't procurement of advanced tech*	13	4.4
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	61	3508.4
3.02	Mobile network coverage, % pop.	54	99.5
3.03	Int'l Internet bandwidth, kb/s per user	125	3.3
3.04	Secure Internet servers/million pop.	111	3.1
3.05	Accessibility of digital content*	67	5.2
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	13	0.07
4.02	Fixed broadband Internet tariffs, PPP $/month	84	35.44
4.03	Internet & telephony competition, 0–2 (best)	110	1.29
	5th pillar: Skills		
5.01	Quality of educational system*	54	4.0
5.02	Quality of math & science education*	48	4.4
5.03	Secondary education gross enrollment rate, %	82	86.6
5.04	Adult literacy rate, %	66	94.3

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	115	80.8
6.02	Individuals using Internet, %	78	42.3
6.03	Households w/ personal computer, %	70	40.9
6.04	Households w/ Internet access, %	72	37.4
6.05	Fixed broadband Internet subs./100 pop.	51	12.7
6.06	Mobile broadband subscriptions/100 pop.	76	16.9
6.07	Use of virtual social networks*	126	4.7
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	71	4.7
7.02	Capacity for innovation*	30	4.2
7.03	PCT patents, applications/million pop.	32	11.5
7.04	Business-to-business Internet use*	66	4.9
7.05	Business-to-consumer Internet use*	41	5.1
7.06	Extent of staff training*	48	4.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	24	4.8
8.02	Government Online Service Index, 0–1 (best)	59	0.53
8.03	Gov't success in ICT promotion*	37	4.8
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	52	4.6
9.02	ICT PCT patents, applications/million pop.	28	4.9
9.03	Impact of ICTs on new organizational models*	35	4.7
9.04	Knowledge-intensive jobs, % workforce	108	7.4
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	45	4.7
10.02	Internet access in schools*	35	5.3
10.03	ICT use & gov't efficiency*	47	4.6
10.04	E-Participation Index, 0–1 (best)	63	0.21

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Colombia

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**63**	**4.0**
Networked Readiness Index 2013 (out of 144)	66	3.9
A. Environment subindex	**101**	**3.6**
1st pillar: Political and regulatory environment	96	3.4
2nd pillar: Business and innovation environment	104	3.9
B. Readiness subindex	**70**	**4.9**
3rd pillar: Infrastructure and digital content	80	3.7
4th pillar: Affordability	44	5.9
5th pillar: Skills	76	4.9
C. Usage subindex	**62**	**3.9**
6th pillar: Individual usage	77	3.4
7th pillar: Business usage	79	3.5
8th pillar: Government usage	31	4.9
D. Impact subindex	**49**	**3.8**
9th pillar: Economic impacts	75	3.2
10th pillar: Social impacts	39	4.4



The Networked Readiness Index in detail

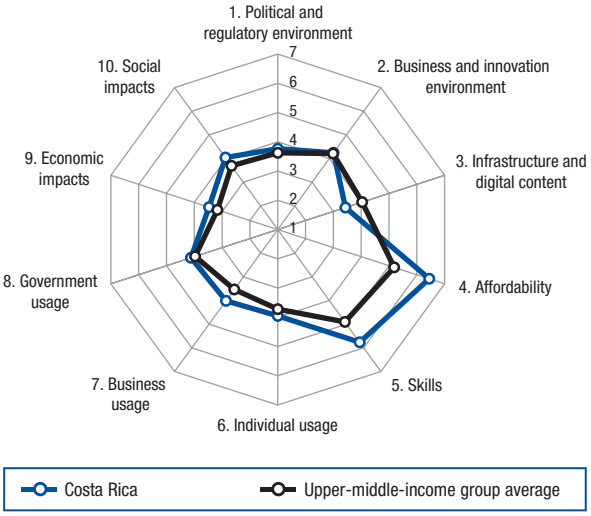
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	124	2.7
1.02	Laws relating to ICTs*	55	4.2
1.03	Judicial independence*	106	3.0
1.04	Efficiency of legal system in settling disputes*	95	3.4
1.05	Efficiency of legal system in challenging regs*	93	3.2
1.06	Intellectual property protection*	95	3.2
1.07	Software piracy rate, % software installed	40	53
1.08	No. procedures to enforce a contract	42	34
1.09	No. days to enforce a contract	139	1288
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	96	4.5
2.02	Venture capital availability*	75	2.6
2.03	Total tax rate, % profits	144	76.0
2.04	No. days to start a business	76	15
2.05	No. procedures to start a business	107	9
2.06	Intensity of local competition*	64	5.1
2.07	Tertiary education gross enrollment rate, %	60	45.0
2.08	Quality of management schools*	70	4.3
2.09	Gov't procurement of advanced tech*	49	3.7
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	94	1313.2
3.02	Mobile network coverage, % pop.	1	100.0
3.03	Int'l Internet bandwidth, kb/s per user	68	20.4
3.04	Secure Internet servers/million pop.	70	28.4
3.05	Accessibility of digital content*	91	4.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	79	0.27
4.02	Fixed broadband Internet tariffs, PPP $/month	45	25.85
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	86	3.5
5.02	Quality of math & science education*	108	3.4
5.03	Secondary education gross enrollment rate, %	63	92.8
5.04	Adult literacy rate, %	71	93.6

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	86	102.9
6.02	Individuals using Internet, %	66	49.0
6.03	Households w/ personal computer, %	74	38.4
6.04	Households w/ Internet access, %	75	32.1
6.05	Fixed broadband Internet subs./100 pop.	69	8.2
6.06	Mobile broadband subscriptions/100 pop.	103	5.0
6.07	Use of virtual social networks*	80	5.6
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	97	4.4
7.02	Capacity for innovation*	83	3.4
7.03	PCT patents, applications/million pop.	68	1.0
7.04	Business-to-business Internet use*	62	4.9
7.05	Business-to-consumer Internet use*	56	4.8
7.06	Extent of staff training*	93	3.7
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	57	4.2
8.02	Government Online Service Index, 0–1 (best)	16	0.84
8.03	Gov't success in ICT promotion*	74	4.3
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	62	4.5
9.02	ICT PCT patents, applications/million pop.	76	0.1
9.03	Impact of ICTs on new organizational models*	56	4.4
9.04	Knowledge-intensive jobs, % workforce	89	16.8
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	70	4.2
10.02	Internet access in schools*	82	3.9
10.03	ICT use & gov't efficiency*	68	4.1
10.04	E-Participation Index, 0–1 (best)	11	0.74

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Costa Rica

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**53**	**4.2**
Networked Readiness Index 2013 (out of 144)	53	4.1
A. Environment subindex	**64**	**4.0**
1st pillar: Political and regulatory environment	63	3.8
2nd pillar: Business and innovation environment	70	4.2
B. Readiness subindex	**50**	**5.2**
3rd pillar: Infrastructure and digital content	92	3.4
4th pillar: Affordability	15	6.4
5th pillar: Skills	24	5.8
C. Usage subindex	**57**	**4.0**
6th pillar: Individual usage	64	3.9
7th pillar: Business usage	38	4.0
8th pillar: Government usage	64	4.1
D. Impact subindex	**50**	**3.8**
9th pillar: Economic impacts	52	3.5
10th pillar: Social impacts	54	4.0



The Networked Readiness Index in detail

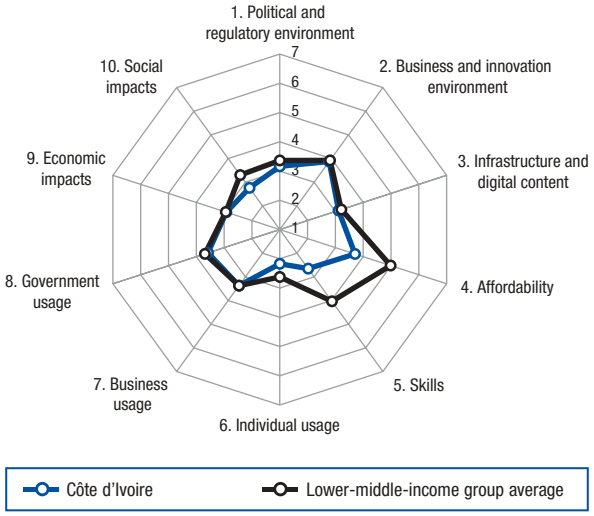
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	140	2.2
1.02	Laws relating to ICTs*	51	4.3
1.03	Judicial independence*	37	4.8
1.04	Efficiency of legal system in settling disputes*	68	3.7
1.05	Efficiency of legal system in challenging regs*	37	4.0
1.06	Intellectual property protection*	59	3.8
1.07	Software piracy rate, % software installed	50	58
1.08	No. procedures to enforce a contract	98	40
1.09	No. days to enforce a contract	123	852
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	49	5.3
2.02	Venture capital availability*	103	2.3
2.03	Total tax rate, % profits	129	55.3
2.04	No. days to start a business	102	24
2.05	No. procedures to start a business	107	9
2.06	Intensity of local competition*	52	5.2
2.07	Tertiary education gross enrollment rate, %	56	46.7
2.08	Quality of management schools*	17	5.3
2.09	Gov't procurement of advanced tech*	66	3.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	83	2075.5
3.02	Mobile network coverage, % pop.	134	69.5
3.03	Int'l Internet bandwidth, kb/s per user	59	29.9
3.04	Secure Internet servers/million pop.	52	94.9
3.05	Accessibility of digital content*	47	5.5
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	22	0.09
4.02	Fixed broadband Internet tariffs, PPP $/month	31	21.59
4.03	Internet & telephony competition, 0–2 (best)	94	1.63
	5th pillar: Skills		
5.01	Quality of educational system*	20	4.9
5.02	Quality of math & science education*	45	4.5
5.03	Secondary education gross enrollment rate, %	32	101.1
5.04	Adult literacy rate, %	58	96.3

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	64	111.9
6.02	Individuals using Internet, %	68	47.5
6.03	Households w/ personal computer, %	66	49.0
6.04	Households w/ Internet access, %	59	47.3
6.05	Fixed broadband Internet subs./100 pop.	64	9.3
6.06	Mobile broadband subscriptions/100 pop.	70	20.3
6.07	Use of virtual social networks*	36	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	43	5.2
7.02	Capacity for innovation*	37	4.0
7.03	PCT patents, applications/million pop.	63	1.2
7.04	Business-to-business Internet use*	43	5.3
7.05	Business-to-consumer Internet use*	47	4.9
7.06	Extent of staff training*	23	4.7
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	71	3.9
8.02	Government Online Service Index, 0–1 (best)	67	0.50
8.03	Gov't success in ICT promotion*	65	4.4
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	45	4.8
9.02	ICT PCT patents, applications/million pop.	60	0.3
9.03	Impact of ICTs on new organizational models*	39	4.6
9.04	Knowledge-intensive jobs, % workforce	65	23.9
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	47	4.6
10.02	Internet access in schools*	58	4.6
10.03	ICT use & gov't efficiency*	76	4.1
10.04	E-Participation Index, 0–1 (best)	47	0.32

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Côte d'Ivoire

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**122**	**3.1**
Networked Readiness Index 2013 (out of 144)	120	3.0
A. Environment subindex	**111**	**3.5**
1st pillar: Political and regulatory environment	116	3.2
2nd pillar: Business and innovation environment	102	3.9
B. Readiness subindex	**124**	**3.2**
3rd pillar: Infrastructure and digital content	105	3.1
4th pillar: Affordability	120	3.7
5th pillar: Skills	133	2.7
C. Usage subindex	**115**	**3.0**
6th pillar: Individual usage	117	2.2
7th pillar: Business usage	96	3.4
8th pillar: Government usage	107	3.6
D. Impact subindex	**119**	**2.8**
9th pillar: Economic impacts	102	2.9
10th pillar: Social impacts	127	2.8



The Networked Readiness Index in detail

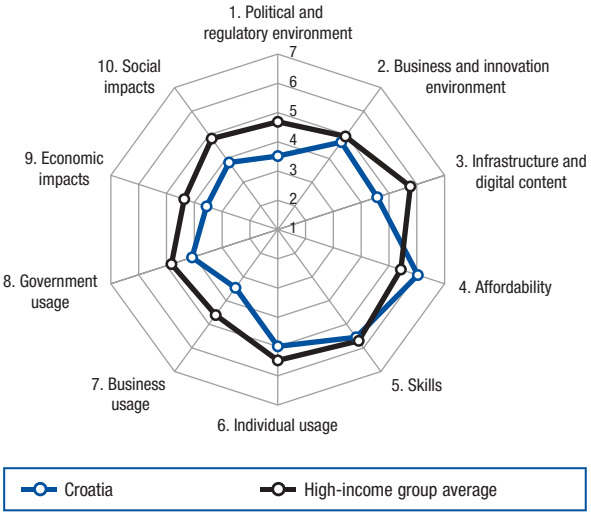
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	103	3.1
1.02	Laws relating to ICTs*	108	3.3
1.03	Judicial independence*	128	2.4
1.04	Efficiency of legal system in settling disputes*	90	3.4
1.05	Efficiency of legal system in challenging regs*	95	3.2
1.06	Intellectual property protection*	123	2.7
1.07	Software piracy rate, % software installed	89	81
1.08	No. procedures to enforce a contract	27	32
1.09	No. days to enforce a contract	85	585
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	94	4.5
2.02	Venture capital availability*	116	2.1
2.03	Total tax rate, % profits	107	46.4
2.04	No. days to start a business	40	8
2.05	No. procedures to start a business	34	5
2.06	Intensity of local competition*	72	5.0
2.07	Tertiary education gross enrollment rate, %	125	8.4
2.08	Quality of management schools*	62	4.3
2.09	Gov't procurement of advanced tech*	43	3.8
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	117	314.5
3.02	Mobile network coverage, % pop.	108	94.5
3.03	Int'l Internet bandwidth, kb/s per user	78	17.0
3.04	Secure Internet servers/million pop.	125	1.5
3.05	Accessibility of digital content*	131	3.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	87	0.30
4.02	Fixed broadband Internet tariffs, PPP $/month	117	63.17
4.03	Internet & telephony competition, 0–2 (best)	116	1.22
	5th pillar: Skills		
5.01	Quality of educational system*	83	3.5
5.02	Quality of math & science education*	60	4.3
5.03	Secondary education gross enrollment rate, %	141	28.9
5.04	Adult literacy rate, %	134	56.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	103	91.2
6.02	Individuals using Internet, %	139	2.4
6.03	Households w/ personal computer, %	141	2.3
6.04	Households w/ Internet access, %	144	1.3
6.05	Fixed broadband Internet subs./100 pop.	133	0.1
6.06	Mobile broadband subscriptions/100 pop.	140	0.0
6.07	Use of virtual social networks*	78	5.6
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	67	4.7
7.02	Capacity for innovation*	127	2.9
7.03	PCT patents, applications/million pop.	105	0.1
7.04	Business-to-business Internet use*	120	4.2
7.05	Business-to-consumer Internet use*	118	3.6
7.06	Extent of staff training*	40	4.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	81	3.8
8.02	Government Online Service Index, 0–1 (best)	106	0.33
8.03	Gov't success in ICT promotion*	98	3.9
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	95	4.0
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	103	3.7
9.04	Knowledge-intensive jobs, % workforce	n/a	n/a
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	124	3.4
10.02	Internet access in schools*	134	2.3
10.03	ICT use & gov't efficiency*	112	3.5
10.04	E-Participation Index, 0–1 (best)	82	0.13

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Croatia

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**46**	**4.3**
Networked Readiness Index 2013 (out of 144)	51	4.2
A. Environment subindex	**58**	**4.1**
1st pillar: Political and regulatory environment	88	3.5
2nd pillar: Business and innovation environment	44	4.7
B. Readiness subindex	**41**	**5.4**
3rd pillar: Infrastructure and digital content	54	4.6
4th pillar: Affordability	36	6.0
5th pillar: Skills	36	5.6
C. Usage subindex	**46**	**4.2**
6th pillar: Individual usage	39	5.0
7th pillar: Business usage	81	3.5
8th pillar: Government usage	65	4.1
D. Impact subindex	**54**	**3.7**
9th pillar: Economic impacts	40	3.6
10th pillar: Social impacts	66	3.8



The Networked Readiness Index in detail

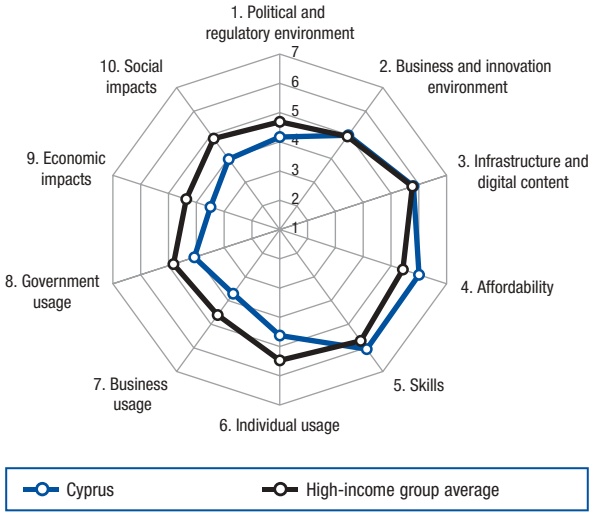
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	92	3.3
1.02	Laws relating to ICTs*	71	4.0
1.03	Judicial independence*	109	3.0
1.04	Efficiency of legal system in settling disputes*	140	2.5
1.05	Efficiency of legal system in challenging regs*	132	2.5
1.06	Intellectual property protection*	81	3.5
1.07	Software piracy rate, % software installed	40	53
1.08	No. procedures to enforce a contract	78	38
1.09	No. days to enforce a contract	83	572
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	59	5.1
2.02	Venture capital availability*	110	2.2
2.03	Total tax rate, % profits	12	19.8
2.04	No. days to start a business	40	8
2.05	No. procedures to start a business	58	6
2.06	Intensity of local competition*	107	4.5
2.07	Tertiary education gross enrollment rate, %	44	58.8
2.08	Quality of management schools*	78	4.2
2.09	Gov't procurement of advanced tech*	136	2.6
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	75	2500.1
3.02	Mobile network coverage, % pop.	1	100.0
3.03	Int'l Internet bandwidth, kb/s per user	60	28.7
3.04	Secure Internet servers/million pop.	36	245.1
3.05	Accessibility of digital content*	42	5.6
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	71	0.24
4.02	Fixed broadband Internet tariffs, PPP $/month	51	26.19
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	97	3.4
5.02	Quality of math & science education*	22	5.0
5.03	Secondary education gross enrollment rate, %	42	98.0
5.04	Adult literacy rate, %	40	98.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	60	115.4
6.02	Individuals using Internet, %	44	63.0
6.03	Households w/ personal computer, %	42	68.0
6.04	Households w/ Internet access, %	39	66.0
6.05	Fixed broadband Internet subs./100 pop.	36	20.7
6.06	Mobile broadband subscriptions/100 pop.	24	53.9
6.07	Use of virtual social networks*	71	5.6
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	76	4.7
7.02	Capacity for innovation*	110	3.1
7.03	PCT patents, applications/million pop.	34	9.8
7.04	Business-to-business Internet use*	49	5.2
7.05	Business-to-consumer Internet use*	65	4.6
7.06	Extent of staff training*	121	3.3
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	98	3.6
8.02	Government Online Service Index, 0–1 (best)	40	0.64
8.03	Gov't success in ICT promotion*	110	3.8
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	64	4.5
9.02	ICT PCT patents, applications/million pop.	37	1.4
9.03	Impact of ICTs on new organizational models*	67	4.2
9.04	Knowledge-intensive jobs, % workforce	40	32.3
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	72	4.2
10.02	Internet access in schools*	53	4.7
10.03	ICT use & gov't efficiency*	94	3.7
10.04	E-Participation Index, 0–1 (best)	52	0.29

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Cyprus

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**37**	**4.6**
Networked Readiness Index 2013 (out of 144)	35	4.6
A. Environment subindex	**39**	**4.6**
1st pillar: Political and regulatory environment	45	4.2
2nd pillar: Business and innovation environment	26	5.0
B. Readiness subindex	**16**	**6.0**
3rd pillar: Infrastructure and digital content	28	5.8
4th pillar: Affordability	39	6.0
5th pillar: Skills	11	6.1
C. Usage subindex	**48**	**4.1**
6th pillar: Individual usage	45	4.6
7th pillar: Business usage	58	3.7
8th pillar: Government usage	66	4.1
D. Impact subindex	**52**	**3.7**
9th pillar: Economic impacts	45	3.5
10th pillar: Social impacts	57	4.0



The Networked Readiness Index in detail

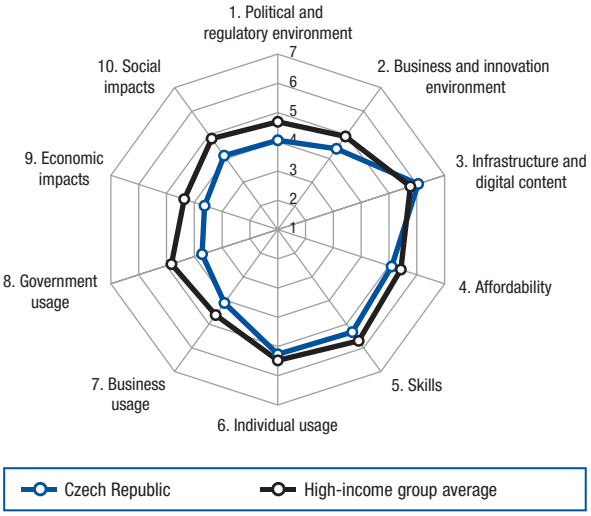
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	46	4.0
1.02	Laws relating to ICTs*	61	4.1
1.03	Judicial independence*	47	4.5
1.04	Efficiency of legal system in settling disputes*	42	4.2
1.05	Efficiency of legal system in challenging regs*	26	4.4
1.06	Intellectual property protection*	40	4.4
1.07	Software piracy rate, % software installed	34	48
1.08	No. procedures to enforce a contract	122	43
1.09	No. days to enforce a contract	115	735
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	41	5.5
2.02	Venture capital availability*	54	2.8
2.03	Total tax rate, % profits	18	22.5
2.04	No. days to start a business	40	8
2.05	No. procedures to start a business	58	6
2.06	Intensity of local competition*	47	5.2
2.07	Tertiary education gross enrollment rate, %	57	46.5
2.08	Quality of management schools*	18	5.3
2.09	Gov't procurement of advanced tech*	72	3.5
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	51	4414.6
3.02	Mobile network coverage, % pop.	32	100.0
3.03	Int'l Internet bandwidth, kb/s per user	32	69.7
3.04	Secure Internet servers/million pop.	20	786.5
3.05	Accessibility of digital content*	40	5.6
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	29	0.12
4.02	Fixed broadband Internet tariffs, PPP $/month	38	23.92
4.03	Internet & telephony competition, 0–2 (best)	109	1.31
	5th pillar: Skills		
5.01	Quality of educational system*	9	5.3
5.02	Quality of math & science education*	7	5.6
5.03	Secondary education gross enrollment rate, %	62	92.8
5.04	Adult literacy rate, %	42	98.7

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	91	98.4
6.02	Individuals using Internet, %	47	61.0
6.03	Households w/ personal computer, %	39	70.0
6.04	Households w/ Internet access, %	45	62.0
6.05	Fixed broadband Internet subs./100 pop.	37	19.2
6.06	Mobile broadband subscriptions/100 pop.	47	34.1
6.07	Use of virtual social networks*	41	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	38	5.2
7.02	Capacity for innovation*	93	3.3
7.03	PCT patents, applications/million pop.	47	5.2
7.04	Business-to-business Internet use*	76	4.8
7.05	Business-to-consumer Internet use*	53	4.9
7.06	Extent of staff training*	67	4.0
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	77	3.9
8.02	Government Online Service Index, 0–1 (best)	51	0.56
8.03	Gov't success in ICT promotion*	96	4.0
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	76	4.3
9.02	ICT PCT patents, applications/million pop.	73	0.1
9.03	Impact of ICTs on new organizational models*	82	4.0
9.04	Knowledge-intensive jobs, % workforce	33	35.0
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	46	4.6
10.02	Internet access in schools*	30	5.6
10.03	ICT use & gov't efficiency*	66	4.2
10.04	E-Participation Index, 0–1 (best)	97	0.08

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Czech Republic

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**42**	**4.5**
Networked Readiness Index 2013 (out of 144)	42	4.4
A. Environment subindex	**49**	**4.2**
1st pillar: Political and regulatory environment	51	4.0
2nd pillar: Business and innovation environment	60	4.4
B. Readiness subindex	**35**	**5.5**
3rd pillar: Infrastructure and digital content	23	6.0
4th pillar: Affordability	84	5.1
5th pillar: Skills	49	5.3
C. Usage subindex	**40**	**4.4**
6th pillar: Individual usage	30	5.3
7th pillar: Business usage	31	4.1
8th pillar: Government usage	96	3.7
D. Impact subindex	**45**	**3.9**
9th pillar: Economic impacts	38	3.6
10th pillar: Social impacts	47	4.1



The Networked Readiness Index in detail

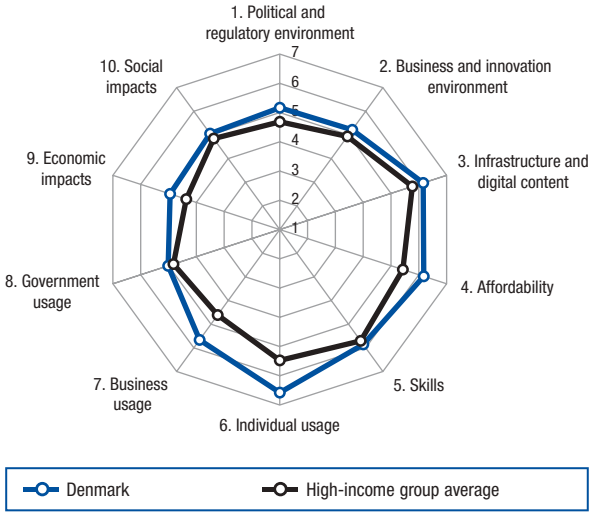
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	110	3.0
1.02	Laws relating to ICTs*	47	4.4
1.03	Judicial independence*	68	3.8
1.04	Efficiency of legal system in settling disputes*	115	3.1
1.05	Efficiency of legal system in challenging regs*	126	2.7
1.06	Intellectual property protection*	61	3.8
1.07	Software piracy rate, % software installed	20	35
1.08	No. procedures to enforce a contract	8	27
1.09	No. days to enforce a contract	95	611
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	53	5.2
2.02	Venture capital availability*	74	2.6
2.03	Total tax rate, % profits	110	48.1
2.04	No. days to start a business	94	20
2.05	No. procedures to start a business	107	9
2.06	Intensity of local competition*	12	5.8
2.07	Tertiary education gross enrollment rate, %	30	64.6
2.08	Quality of management schools*	90	4.0
2.09	Gov't procurement of advanced tech*	124	2.8
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	23	8260.3
3.02	Mobile network coverage, % pop.	43	99.8
3.03	Int'l Internet bandwidth, kb/s per user	19	100.1
3.04	Secure Internet servers/million pop.	27	518.6
3.05	Accessibility of digital content*	19	6.1
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	118	0.43
4.02	Fixed broadband Internet tariffs, PPP $/month	63	29.20
4.03	Internet & telephony competition, 0–2 (best)	69	1.87
	5th pillar: Skills		
5.01	Quality of educational system*	67	3.7
5.02	Quality of math & science education*	83	4.0
5.03	Secondary education gross enrollment rate, %	52	96.0
5.04	Adult literacy rate, %	14	99.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	41	126.9
6.02	Individuals using Internet, %	28	75.0
6.03	Households w/ personal computer, %	34	75.0
6.04	Households w/ Internet access, %	33	71.0
6.05	Fixed broadband Internet subs./100 pop.	40	16.4
6.06	Mobile broadband subscriptions/100 pop.	29	52.1
6.07	Use of virtual social networks*	43	6.0
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	54	4.9
7.02	Capacity for innovation*	26	4.3
7.03	PCT patents, applications/million pop.	29	15.3
7.04	Business-to-business Internet use*	24	5.7
7.05	Business-to-consumer Internet use*	9	5.8
7.06	Extent of staff training*	68	4.0
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	113	3.3
8.02	Government Online Service Index, 0–1 (best)	53	0.54
8.03	Gov't success in ICT promotion*	116	3.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	78	4.3
9.02	ICT PCT patents, applications/million pop.	32	2.3
9.03	Impact of ICTs on new organizational models*	73	4.1
9.04	Knowledge-intensive jobs, % workforce	26	37.3
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	58	4.5
10.02	Internet access in schools*	24	5.8
10.03	ICT use & gov't efficiency*	101	3.6
10.04	E-Participation Index, 0–1 (best)	55	0.26

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Denmark

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**13**	**5.5**
Networked Readiness Index 2013 (out of 144)	8	5.6
A. Environment subindex	**16**	**5.2**
1st pillar: Political and regulatory environment	19	5.2
2nd pillar: Business and innovation environment	18	5.2
B. Readiness subindex	**14**	**6.1**
3rd pillar: Infrastructure and digital content	20	6.2
4th pillar: Affordability	29	6.2
5th pillar: Skills	18	5.9
C. Usage subindex	**7**	**5.7**
6th pillar: Individual usage	3	6.6
7th pillar: Business usage	7	5.7
8th pillar: Government usage	26	5.0
D. Impact subindex	**19**	**5.0**
9th pillar: Economic impacts	16	4.9
10th pillar: Social impacts	24	5.0



The Networked Readiness Index in detail

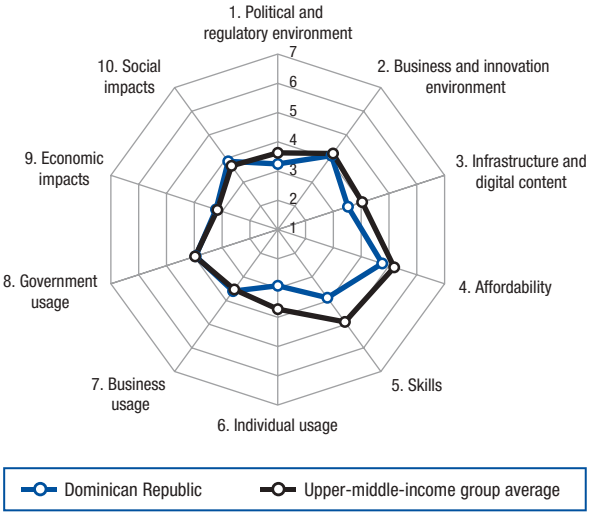
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	23	4.7
1.02	Laws relating to ICTs*	18	5.1
1.03	Judicial independence*	8	6.2
1.04	Efficiency of legal system in settling disputes*	21	4.9
1.05	Efficiency of legal system in challenging regs*	38	4.0
1.06	Intellectual property protection*	26	5.0
1.07	Software piracy rate, % software installed	7	24
1.08	No. procedures to enforce a contract	47	35
1.09	No. days to enforce a contract	35	410
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	29	5.9
2.02	Venture capital availability*	95	2.4
2.03	Total tax rate, % profits	29	27.0
2.04	No. days to start a business	19	6
2.05	No. procedures to start a business	22	4
2.06	Intensity of local competition*	27	5.5
2.07	Tertiary education gross enrollment rate, %	19	73.6
2.08	Quality of management schools*	25	5.2
2.09	Gov't procurement of advanced tech*	87	3.4
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	40	5438.4
3.02	Mobile network coverage, % pop.	88	97.0
3.03	Int'l Internet bandwidth, kb/s per user	12	174.8
3.04	Secure Internet servers/million pop.	5	2214.3
3.05	Accessibility of digital content*	29	6.0
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	11	0.06
4.02	Fixed broadband Internet tariffs, PPP $/month	73	32.19
4.03	Internet & telephony competition, 0–2 (best)	65	1.88
	5th pillar: Skills		
5.01	Quality of educational system*	21	4.9
5.02	Quality of math & science education*	42	4.5
5.03	Secondary education gross enrollment rate, %	5	119.5
5.04	Adult literacy rate, %	14	99.0

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	56	117.6
6.02	Individuals using Internet, %	4	93.0
6.03	Households w/ personal computer, %	4	92.2
6.04	Households w/ Internet access, %	6	92.0
6.05	Fixed broadband Internet subs./100 pop.	3	38.8
6.06	Mobile broadband subscriptions/100 pop.	6	97.2
6.07	Use of virtual social networks*	46	5.9
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	20	5.7
7.02	Capacity for innovation*	13	5.0
7.03	PCT patents, applications/million pop.	7	208.5
7.04	Business-to-business Internet use*	21	5.7
7.05	Business-to-consumer Internet use*	18	5.6
7.06	Extent of staff training*	14	5.0
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	48	4.3
8.02	Government Online Service Index, 0–1 (best)	13	0.86
8.03	Gov't success in ICT promotion*	50	4.6
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	33	4.9
9.02	ICT PCT patents, applications/million pop.	11	38.0
9.03	Impact of ICTs on new organizational models*	29	4.8
9.04	Knowledge-intensive jobs, % workforce	9	45.2
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	28	5.2
10.02	Internet access in schools*	22	5.8
10.03	ICT use & gov't efficiency*	34	4.8
10.04	E-Participation Index, 0–1 (best)	28	0.55

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Dominican Republic

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**93**	**3.7**
Networked Readiness Index 2013 (out of 144)	90	3.6
A. Environment subindex	**97**	**3.7**
1st pillar: Political and regulatory environment	110	3.2
2nd pillar: Business and innovation environment	79	4.1
B. Readiness subindex	**103**	**4.0**
3rd pillar: Infrastructure and digital content	87	3.5
4th pillar: Affordability	95	4.7
5th pillar: Skills	106	3.9
C. Usage subindex	**87**	**3.5**
6th pillar: Individual usage	93	2.9
7th pillar: Business usage	67	3.6
8th pillar: Government usage	81	3.9
D. Impact subindex	**64**	**3.6**
9th pillar: Economic impacts	71	3.2
10th pillar: Social impacts	61	3.9



The Networked Readiness Index in detail

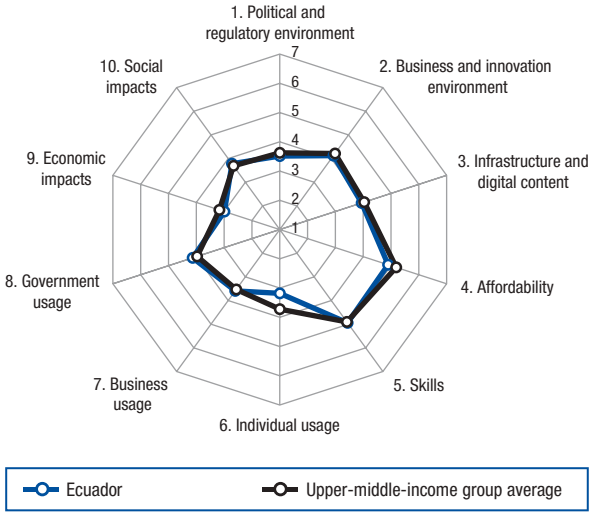
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	129	2.7
1.02	Laws relating to ICTs*	73	4.0
1.03	Judicial independence*	131	2.4
1.04	Efficiency of legal system in settling disputes*	99	3.4
1.05	Efficiency of legal system in challenging regs*	107	3.0
1.06	Intellectual property protection*	107	3.0
1.07	Software piracy rate, % software installed	78	76
1.08	No. procedures to enforce a contract	42	34
1.09	No. days to enforce a contract	49	460
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	51	5.2
2.02	Venture capital availability*	86	2.5
2.03	Total tax rate, % profits	97	43.5
2.04	No. days to start a business	89	19
2.05	No. procedures to start a business	79	7
2.06	Intensity of local competition*	75	4.9
2.07	Tertiary education gross enrollment rate, %	76	34.0
2.08	Quality of management schools*	106	3.7
2.09	Gov't procurement of advanced tech*	80	3.4
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	95	1278.6
3.02	Mobile network coverage, % pop.	107	94.6
3.03	Int'l Internet bandwidth, kb/s per user	84	14.9
3.04	Secure Internet servers/million pop.	78	23.0
3.05	Accessibility of digital content*	60	5.3
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	116	0.42
4.02	Fixed broadband Internet tariffs, PPP $/month	96	39.51
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	140	2.5
5.02	Quality of math & science education*	146	2.2
5.03	Secondary education gross enrollment rate, %	98	75.1
5.04	Adult literacy rate, %	87	90.1

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	106	86.9
6.02	Individuals using Internet, %	74	45.0
6.03	Households w/ personal computer, %	96	19.8
6.04	Households w/ Internet access, %	99	13.7
6.05	Fixed broadband Internet subs./100 pop.	83	4.3
6.06	Mobile broadband subscriptions/100 pop.	78	15.6
6.07	Use of virtual social networks*	51	5.9
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	56	4.9
7.02	Capacity for innovation*	98	3.2
7.03	PCT patents, applications/million pop.	83	0.4
7.04	Business-to-business Internet use*	53	5.1
7.05	Business-to-consumer Internet use*	61	4.7
7.06	Extent of staff training*	76	4.0
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	104	3.5
8.02	Government Online Service Index, 0–1 (best)	55	0.54
8.03	Gov't success in ICT promotion*	85	4.1
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	57	4.6
9.02	ICT PCT patents, applications/million pop.	80	0.0
9.03	Impact of ICTs on new organizational models*	44	4.5
9.04	Knowledge-intensive jobs, % workforce	85	17.3
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	80	4.0
10.02	Internet access in schools*	99	3.6
10.03	ICT use & gov't efficiency*	74	4.1
10.04	E-Participation Index, 0–1 (best)	34	0.47

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97

Ecuador

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**82**	**3.9**
Networked Readiness Index 2013 (out of 144)	91	3.6
A. Environment subindex	**81**	**3.8**
1st pillar: Political and regulatory environment	89	3.5
2nd pillar: Business and innovation environment	78	4.1
B. Readiness subindex	**83**	**4.6**
3rd pillar: Infrastructure and digital content	75	3.9
4th pillar: Affordability	92	4.9
5th pillar: Skills	75	4.9
C. Usage subindex	**74**	**3.6**
6th pillar: Individual usage	83	3.2
7th pillar: Business usage	71	3.6
8th pillar: Government usage	62	4.1
D. Impact subindex	**80**	**3.4**
9th pillar: Economic impacts	95	3.0
10th pillar: Social impacts	71	3.8



The Networked Readiness Index in detail

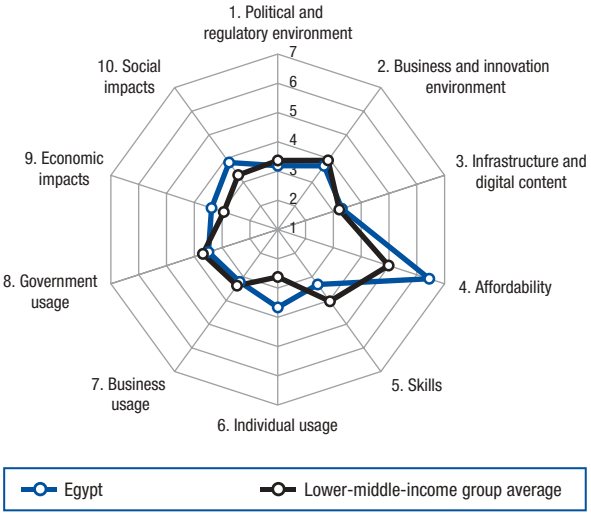
	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	91	3.3
1.02	Laws relating to ICTs*	65	4.0
1.03	Judicial independence*	100	3.2
1.04	Efficiency of legal system in settling disputes*	97	3.4
1.05	Efficiency of legal system in challenging regs*	100	3.1
1.06	Intellectual property protection*	79	3.6
1.07	Software piracy rate, % software installed	67	68
1.08	No. procedures to enforce a contract	91	39
1.09	No. days to enforce a contract	86	588
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	89	4.6
2.02	Venture capital availability*	34	3.2
2.03	Total tax rate, % profits	57	33.9
2.04	No. days to start a business	134	56
2.05	No. procedures to start a business	137	13
2.06	Intensity of local competition*	112	4.5
2.07	Tertiary education gross enrollment rate, %	69	38.9
2.08	Quality of management schools*	77	4.2
2.09	Gov't procurement of advanced tech*	29	4.0
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	91	1329.2
3.02	Mobile network coverage, % pop.	96	96.0
3.03	Int'l Internet bandwidth, kb/s per user	55	31.8
3.04	Secure Internet servers/million pop.	79	22.1
3.05	Accessibility of digital content*	97	4.6
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	104	0.36
4.02	Fixed broadband Internet tariffs, PPP $/month	99	41.06
4.03	Internet & telephony competition, 0–2 (best)	1	2.00
	5th pillar: Skills		
5.01	Quality of educational system*	62	3.8
5.02	Quality of math & science education*	84	4.0
5.03	Secondary education gross enrollment rate, %	80	86.8
5.04	Adult literacy rate, %	82	91.6

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	81	106.2
6.02	Individuals using Internet, %	88	35.1
6.03	Households w/ personal computer, %	82	32.2
6.04	Households w/ Internet access, %	84	22.5
6.05	Fixed broadband Internet subs./100 pop.	77	5.3
6.06	Mobile broadband subscriptions/100 pop.	68	21.6
6.07	Use of virtual social networks*	103	5.1
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	87	4.5
7.02	Capacity for innovation*	53	3.7
7.03	PCT patents, applications/million pop.	81	0.4
7.04	Business-to-business Internet use*	95	4.6
7.05	Business-to-consumer Internet use*	57	4.8
7.06	Extent of staff training*	61	4.1
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	58	4.2
8.02	Government Online Service Index, 0–1 (best)	80	0.46
8.03	Gov't success in ICT promotion*	62	4.5
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	83	4.2
9.02	ICT PCT patents, applications/million pop.	93	0.0
9.03	Impact of ICTs on new organizational models*	66	4.2
9.04	Knowledge-intensive jobs, % workforce	98	14.6
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	66	4.3
10.02	Internet access in schools*	80	4.0
10.03	ICT use & gov't efficiency*	55	4.4
10.04	E-Participation Index, 0–1 (best)	59	0.24

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97.

Egypt

	Rank (out of 148)	Value (1–7)
Networked Readiness Index 2014	**91**	**3.7**
Networked Readiness Index 2013 (out of 144)	80	3.8
A. Environment subindex	**119**	**3.4**
1st pillar: Political and regulatory environment	115	3.2
2nd pillar: Business and innovation environment	117	3.7
B. Readiness subindex	**93**	**4.4**
3rd pillar: Infrastructure and digital content	99	3.3
4th pillar: Affordability	16	6.4
5th pillar: Skills	120	3.3
C. Usage subindex	**89**	**3.5**
6th pillar: Individual usage	71	3.7
7th pillar: Business usage	112	3.2
8th pillar: Government usage	113	3.5
D. Impact subindex	**61**	**3.6**
9th pillar: Economic impacts	59	3.4
10th pillar: Social impacts	65	3.8



The Networked Readiness Index in detail

	INDICATOR	RANK/148	VALUE
	1st pillar: Political and regulatory environment		
1.01	Effectiveness of law-making bodies*	135	2.4
1.02	Laws relating to ICTs*	104	3.4
1.03	Judicial independence*	82	3.5
1.04	Efficiency of legal system in settling disputes*	106	3.2
1.05	Efficiency of legal system in challenging regs*	94	3.2
1.06	Intellectual property protection*	94	3.2
1.07	Software piracy rate, % software installed	53	61
1.08	No. procedures to enforce a contract	116	42
1.09	No. days to enforce a contract	132	1010
	2nd pillar: Business and innovation environment		
2.01	Availability of latest technologies*	117	4.1
2.02	Venture capital availability*	51	2.9
2.03	Total tax rate, % profits	94	42.6
2.04	No. days to start a business	40	8
2.05	No. procedures to start a business	79	7
2.06	Intensity of local competition*	131	4.1
2.07	Tertiary education gross enrollment rate, %	79	28.8
2.08	Quality of management schools*	145	2.3
2.09	Gov't procurement of advanced tech*	116	3.0
	3rd pillar: Infrastructure and digital content		
3.01	Electricity production, kWh/capita	84	1972.3
3.02	Mobile network coverage, % pop.	43	99.8
3.03	Int'l Internet bandwidth, kb/s per user	117	4.2
3.04	Secure Internet servers/million pop.	107	3.7
3.05	Accessibility of digital content*	89	4.7
	4th pillar: Affordability		
4.01	Mobile cellular tariffs, PPP $/min.	8	0.05
4.02	Fixed broadband Internet tariffs, PPP $/month	11	15.09
4.03	Internet & telephony competition, 0–2 (best)	103	1.36
	5th pillar: Skills		
5.01	Quality of educational system*	145	2.2
5.02	Quality of math & science education*	145	2.2
5.03	Secondary education gross enrollment rate, %	97	75.9
5.04	Adult literacy rate, %	113	73.9

	INDICATOR	RANK/148	VALUE
	6th pillar: Individual usage		
6.01	Mobile phone subscriptions/100 pop.	51	119.9
6.02	Individuals using Internet, %	75	44.1
6.03	Households w/ personal computer, %	76	37.9
6.04	Households w/ Internet access, %	74	32.3
6.05	Fixed broadband Internet subs./100 pop.	91	2.8
6.06	Mobile broadband subscriptions/100 pop.	59	27.9
6.07	Use of virtual social networks*	50	5.9
	7th pillar: Business usage		
7.01	Firm-level technology absorption*	110	4.2
7.02	Capacity for innovation*	111	3.1
7.03	PCT patents, applications/million pop.	75	0.6
7.04	Business-to-business Internet use*	81	4.7
7.05	Business-to-consumer Internet use*	70	4.5
7.06	Extent of staff training*	138	3.1
	8th pillar: Government usage		
8.01	Importance of ICTs to gov't vision*	141	2.6
8.02	Government Online Service Index, 0–1 (best)	42	0.60
8.03	Gov't success in ICT promotion*	131	3.3
	9th pillar: Economic impacts		
9.01	Impact of ICTs on new services & products*	101	3.9
9.02	ICT PCT patents, applications/million pop.	70	0.2
9.03	Impact of ICTs on new organizational models*	78	4.0
9.04	Knowledge-intensive jobs, % workforce	35	34.0
	10th pillar: Social impacts		
10.01	Impact of ICTs on access to basic services*	92	3.8
10.02	Internet access in schools*	125	2.7
10.03	ICT use & gov't efficiency*	96	3.7
10.04	E-Participation Index, 0–1 (best)	15	0.68

Note: Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" on page 97