Executive Summary

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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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