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Harnessing the Data Revolution to Achieve the Sustainable Development Goals

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Executive Summary

Functioning societies collect accurate data and utilize the evidence to inform policy. The use of evidence derived from data in policymaking requires the capability to collect and analyze accurate data, clear administrative channels through which timely evidence is made available to decision-makers, and the political will to rely on—and ideally share—the evidence. The collection of accurate and timely data, especially in the developing world, is often logistically difficult, not politically expedient, and/or expensive.

Before launching its second round of global goals—the Sustainable Development Goals (SDGs)—the United Nations convened a High Level Panel of Eminent Persons on the Post-2015 Development Agenda. As part of its final report, the Panel called for a "data revolution" and recommended the formation of an independent body to lead the charge.[1] The report resulted in the creation of the Global Partnership for Sustainable Development Data (GPSDD)—an independent group of countries, companies, data communities, and NGOs—and the SDG Data Labs, a private initiative partnered with the GPSDD. In doing so the United Nations and its partners signaled broad interest in data and evidence-based policymaking at a high level. In fact, the GPSDD calls for the "revolution in data" by addressing the "crisis of non-existent, inaccessible or unreliable data."[2] As this report shows, this is easier said than done.

This report defines the *data revolution* as an unprecedented increase in the volume and types of data—and the subsequent demand for them—thanks to the ongoing yet uneven proliferation of new technologies. This revolution is allowing governments, companies, researchers, and citizens to monitor progress and drive action, often with real-time, dynamic, disaggregated data. Much

1. High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development* (New York: United Nations, 2013), https://sustainabledevelopment.un.org/content/documents/8932013-05%20-%20HLP%20Report%20-%20A%20New%20Global%20Partnership.pdf.

2. Global Partnership for Sustainable Development Data, "The Data Ecosystem and the Global Partnership," 2016, http://www.data4sdgs.org/who-we-are/.

work will be needed to make sure the data revolution reaches developing countries facing difficult challenges (i.e., before the data revolution fully becomes the data revolution for sustainable development). It is important to think of the revolution as a multistep process, beginning with building basic knowledge and awareness of the value of data. This is followed by a more specific focus on public private partnerships, opportunities, and constraints regarding collection and utilization of data for evidence-based policy decisions.

Unlike the common perception of "revolution" as being relatively quick, broad, and transformational, the data revolution may be slow, country context specific, and incremental. Building on the momentum created by the adoption of the SDGs in late 2015,[3] the international community can have a critical role to play in supporting national agendas and driving development.

This report analyzes the challenges and opportunities that exist in the pursuit of the data revolution. It considers the challenges faced by two developing countries—Laos and Myanmar—in the broader context of what will be needed to enable "leapfrog" data technologies to take hold and ultimately drive the data revolution without following the linear progression of development laid out by OECD countries. To achieve this outcome, developing countries will need to build domestic institutional capacity to use and maintain new technologies, understand and analyze the data collected, and identify and implement change based on that analysis.

Many outside the developing world are considering the endless possibilities presented by "big data." For many in the developing world—especially those in statistical agencies and other entities responsible for data collection, dissemination, and analysis—big data is not even on the radar. These governments face enough challenges to utilization of "small data" and evidence more broadly in policymaking. Even when they acknowledge the benefits of creating an environment in which leapfrog data technologies could flourish and support such policies, further execution challenges remain.

This report categorizes the many *challenges facing developing country governments* on the road to the data revolution—and then, ideally, measurable sustainable development—as follows:

- Addressing capacity constraints at all levels
- Creating the appropriate enabling environment for leapfrog data technologies to have transformational impact
- Confronting data sharing, ownership, and privacy concerns
- Navigating complex political environments

Thankfully, developing country governments are not alone. While funding has not increased to the extent necessary, the international community has embraced its post-MDG role in the data revolution. There are several ways this support can be strengthened.

This report provides the following *recommendations to the international community* to play a constructive role in the data revolution:

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3. UN General Assembly, "Resolution Adopted by the General Assembly on 25 September 2015: 70/1. Transforming Our World: The 2030 Agenda for Sustainable Development," http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

1. Don't fixate on big data alone. Focus on the foundation necessary to facilitate leapfrogs around all types of data: small, big, and everywhere in between.
2. Increase funding for capacity building as part of an expansion of broader educational development priorities.
3. Highlight, share, and support enlightened government-driven approaches to data.
4. Increase funding for the data revolution and coordinate donor efforts.
5. Coordinate UN data revolution-related activities closely with an expanded GPSDD.
6. Secure consensus on data sharing, ownership, and privacy-related international standards.

This report shows that *a solid foundation to enable leapfrog data technologies is critical*. The ability to collect and utilize accurate data—however small or large—matters, especially in developing countries. However, there must be a solid foundation of infrastructure, skills, and political will on which to build. Promising examples of opportunities for deploying such technologies can be identified; strong enabling foundations will be essential for these opportunities to achieve their full transformational potential. A number of examples of how this is currently being done are presented in this report. These should be seen as useful, tangible, and transferable examples of how to incorporate leapfrog data technologies into policy environments.

This report also demonstrates the importance of the international community. Through the GPSDD and other multi- and bilateral channels, the international community has a significant role to play in realizing transformative innovation through evidence-based policymaking in the developing world.

Though not without its bumps and turns, the road to the data revolution is paved with promise and possibility.

01

Introduction

CONTEXT

The term *data revolution*—especially as it relates to development—is new; however, accurate, widespread data (like census information) have been critical to government function for thousands of years. Governments have realized the importance and value of data for quite some time. A recent report found that utilization of public data reduced death rates among cardiac patients in the United Kingdom and that the total economic value of these types of data just in the United Kingdom was around £5 billion per year.[1] Another report estimates the global value of data at US$3 trillion, though these benefits accrue primarily to the United States and countries in Europe.[2] Though the importance and value of data is becoming more readily apparent—thanks in part to increasing studies like the ones cited above—institutions have long dealt with weaknesses in national capacity and the low priority assigned to addressing these weaknesses.

The current revolution in data is being driven by a confluence of modern data collection and analysis technologies—ranging from satellite and mobile phones to wireless sensors and biometric analysis—and growing political momentum to address historical weaknesses (i.e., for more effective collection, analysis, and integration of data into key decisionmaking processes that will be vital to attainment of ambitious global goals).

The data revolution has a series of constituent parts, and was defined in the broadest of terms by the UN High Level Panel of Eminent Persons on the Post-2015 Development Agenda. The High Level Panel's 2013 report noted that "a true data revolution would draw on existing and new sources of data to fully integrate statistics into decisionmaking, promote open access to, and use

1. Deloitte, *Market Assessment of Public Sector Information* (London: UK Department for Business Innovation and Skills, 2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/198905/bis-13-743-market-assessment-of-public-sector-information.pdf.

2. Michael Chui, Diana Farrell, and Kate Jackson, "How Government Can Promote Open Data," McKinsey & Company, April 2014, http://www.mckinsey.com/industries/public-sector/our-insights/how-government-can-promote-open-data.

of, data and ensure increased support for statistical systems."[3] It also leaned on the assumption that the emerging concepts of "open data" and "big data" could be leveraged as part of the broader development data revolution.

The term *open data* is relatively new, but the concept is old: data should be free and available to the public so that scientists, governments, businesses, and individuals can make use of them.[4] Public library systems have housed and distributed free information for centuries, and the concept of readily available scientific data was popularized in the last century.[5] Open-source technology and crowdsourcing techniques are both examples of open data put into practice. Initiatives, like the Open Government Partnership, provide open data platforms allowing citizen groups to hold their governments more accountable.

The definition of *big data*—and more specifically, what qualifies as big—has also undergone changes in recent years. As data storage methods change—from analogue methods such as microfilm to cloud computing—the size of data unable to be manipulated using standard statistical methods has also changed. *Big data* originally referred only to these large data sets, but now has a series of associated characteristics.[6] These are known as the three Vs: Volume (quantity of data), Velocity (speed at which data are created), and Variety (type or source of data).

Data analysis enables governments to learn more about the needs and concerns of their citizens and, ultimately, serve them more effectively and efficiently. Whether administering the groundbreaking U.S. census of 1880 or analyzing Facebook metadata around an election, big data collection requires interpretation, and increasingly, that interpretation requires new technologies.[7] This is a new and complex arena that requires innovation and experimentation to get the right incentive structures and data-sharing agreements and to address privacy and security concerns. More than 90 percent of existing data has been generated in the last two years alone, with 2.5 quintillion bytes of data generated each day.[8] These data—flowing from a variety of sources including social media, online banking and shopping, global imaging software, and medical records, to name a few—collectively tells a complex story about economic, social, and environmental trends. While complex, understanding this story is vital to fully capitalizing on the development data revolution.

Data collection and access for businesses can play an important role in generating economic growth. A partnership between the U.S. Agency for International Development (USAID) and Telenor, a mobile phone network in Pakistan, has given rise to a mobile solution for farmers in rural

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3. High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development* (New York: United Nations, 2013), 23, https://sustainabledevelopment.un.org/content/documents/8932013-05%20-%20HLP%20Report%20-%20A%20New%20Global%20Partnership.pdf.

4. "What Is Open Data?," Open Data Handbook, accessed July 7, 2017, http://opendatahandbook.org/guide/en/what-is-open-data/.

5. "Open Data: A History," Data.gov, April 4, 2013, https://www.data.gov/blog/open-data-history.

6. "What Is Big Data? Gartner IT Glossary—Big Data," March 17, 2017, http://www.gartner.com/it-glossary/big-data.

7. Census History Staff U.S. Census Bureau, "1880 Overview—History—U.S. Census Bureau," accessed June 7, 2017, https://www.census.gov/history/www/through_the_decades/overview/1880.html.

8. Ibid.

Pakistan.[9] These farmers can now access information about market prices, weather patterns, new farming techniques, and other tools that help them grow and sell their crops at a fair price. Fujitsu has also developed a series of smart agriculture tools that rely on sensor technology and cloud computing to monitor growth, forecast weather, and distribute water and fertilizer in the most efficient way possible; these tools could significantly increase productivity and competitiveness for small farms in remote areas.[10] These technology tools also serve to embed data analysis capabilities, which are also an important part of capacity building.

Beyond advances in mobile technology, however, the developing world has lagged on many valuable data breakthroughs. Returns on investment in data are very slow, the business case for data-related research is still young,[11] and developing countries and international investors may be more focused on measurable, short-term gains. Data collected from mobile technology are an exception, since these data are easy and inexpensive to collect.[12] The proliferation of cell phone ownership in parts of Africa and Asia creates a two-way street for data; more people have access to information through their cellular phones, and more data points are created by those with cell phones.[13] Even these easy and inexpensive data, however, require baseline investments in core infrastructure and human capital.

Supply-chain analytics is another exception. Corporations can collect "small data" about themselves and their supply chains, which often extend into the developing world.[14] It is possible that corporations, not governments, can lead the data revolution in emerging markets.

THE ROLE OF INTERNATIONAL INSTITUTIONS

With a few exceptions, the data revolution is yet to arrive in the developing world. This report expands on the challenges facing developing countries; however, despite the uneven technological penetration in developing countries, data collection and analysis is a priority for development-focused organizations. PARIS21, the Partnership in Statistics for Development in the 21st Century, was launched in 1999 as a joint initiative of the United Nations, the European Commission, the Organization for Economic Cooperation and Development, the International Monetary Fund, and

9. "Mobile Solutions," USAID Impact, accessed July 7, 2017, https://blog.usaid.gov/category/mobile-solutions/.

10. "Akisai: Introduction of Fujitsu's Food and Agriculture Cloud," Fujitsu, February 26, 2015, https://www.fujitsu.com/global/Images/presentation-20150226-01.pdf.

11. Dan Wetherill, "Broken Links: Why Analytics Investments Have Yet To Pay Off," ZS, June 2016, https://www.zs.com/-/media/files/publications/public/broken-links-why-analytics-investments-have-yet-to-pay-off.pdf?la=enhttps://www.zs.com/-/media/files/publications/public/broken-links-why-analytics-investments-have-yet-to-pay-off.pdf?la=en.

12. Mark van Rijmenam, "How Big Data Can Help the Developing World Beat Poverty," SmartData Collective, August 2, 2013, http://www.smartdatacollective.com/bigdatastartups/137586/how-big-data-can-help-developing-world-beat-poverty.

13. "Cell Phones in Africa: Communication Lifeline," Pew Research Center's Global Attitudes Project, April 15, 2015, http://www.pewglobal.org/2015/04/15/cell-phones-in-africa-communication-lifeline/.

14. Jim Lee, Phillip Savio, and Carey Carpenter, "Supply Chain Analytics in Emerging Markets," *Supply Chain Brain*, February 21, 2014, http://www.supplychainbrain.com/content/technology-solutions/business-intelligence-analytics/single-article-page/article/supply-chain-analytics-in-emerging-markets/.

the World Bank in "response to the challenges faced by both statisticians and decision-makers."[15] A "help desk" of sorts for developing countries, PARIS21 supports statistical capacity building, guideline creation, and results monitoring.

The Millennium Development Goals (MDGs) sought to create reachable, measurable goals for progress in the developing world. Data gaps and discrepancies, however, impeded accurate monitoring and evaluation of that progress.[16] Additionally, all countries were unrealistically expected to proceed in a uniform fashion, making equal progress every year toward every goal. The Sustainable Development Goals (SDGs), created in 2015 to build on successes, expand on the MDGs, and define a new set of priorities for a new geopolitical moment, include a target on "data, monitoring, and accountability" as part of Goal 17, which focuses on strengthening means of implementation.[17] The Inter-Agency and Expert Group on SDG indicators has developed three indicators for this target. Addressing the MDGs' struggle with uniform progress, the SDGs promote "common but differentiated responsibilities" and emphasize that "each country has primary responsibility for its own economic and social development."[18]

Monitoring progress toward the SDGs will require a broad effort to collect and report accurate and timely data. This effort will need to be shared by governments and international organizations alongside nongovernmental actors in the private sector and civil society.[19] A whole ecosystem of additional initiatives supporting—and funding—the data revolution for sustainable development (some of which are discussed below and in Appendix A) exists beyond the Global Partnership, SDG Data Labs, UN agencies, and others mentioned above. Their efforts must be coordinated closely, ideally via the Global Partnership.

The World Bank has been collecting data through the International Comparison Program (ICP) since 1968.[20] The ICP focuses on purchasing power parity (PPP) metrics, collecting GDP information from up to 199 countries. While this type of data collection is primarily on the national, and not individual, level, the World Bank established a Trust Fund for Statistical Capacity Building (TFSCB) in 1999 to build capacity within governments to collect and analyze data.[21] The TFSCB is a multidonor trust fund synchronized with PARIS21 and has funded more than 200 projects

15. "PARIS21.org | Improving Lives through Better Statistics," accessed June 7, 2017, http://www.paris21.org/.

16. Dimitri Sanga, "The Challenges of Monitoring and Reporting on the Millennium Development Goals in Africa by 2015 and Beyond," *African Statistical Journal* 12 (May 2011), https://pdfs.semanticscholar.org/5643/7109cf704c02e3b2f1c7c909c622ae28d36b.pdf.

17. "Revised List of Global Sustainable Development Goal Indicators," accessed July 7, 2017, https://unstats.un.org/sdgs/indicators/Official Revised List of global SDG indicators.pdf.

18. "Resolution Adopted by the General Assembly: 70/1 Transforming Our World: The 2030 Agenda for Sustainable Development," 1.

19. "Data for Development: A Needs Assessment for SDG Monitoring and Statistical Capacity Development," *Sustainable Development Solutions Network*, April 17, 2015, http://unsdsn.org/wp-content/uploads/2015/04/Data-for-Development-Full-Report.pdf.

20. "International Comparison Program (ICP)," Text/HTML, World Bank, accessed July 7, 2017, http://www.worldbank.org/en/programs/icp.

21. "Statistical Capacity Building," accessed July 7, 2017, http://www.worldbank.org/en/data/statistical-capacity-building.

worldwide.[22] The TFSCB serves as a vehicle for countries to strengthen their statistical abilities and monitoring through the Busan Action Plan for Statistics (BAPS), proposed by the World Bank.[23] The World Bank also has a Development Data Group housed under the Development Economics (DEC) Vice Presidency.[24] Additionally, the World Bank published the "Atlas of Sustainable Development Goals" to track world development indicators at the 2017 spring meetings of the World Bank and IMF.[25]

BAPS was approved at the Fourth High-Level Forum on Aid Effectiveness held in Busan, Republic of Korea, in 2011 by more than 3,000 delegates from the United Nations, OECD, INGOs, and national leaders. BAPS is considered a framework for the data revolution, designed to further improve and expand statistical capacities though better transparency and accountability.[26] New technologies emphasized in BAPS to spur the data revolution include using big data, integrating data collected through mobile devices and social media, and better utilizing officially collected government data.[27]

In July 2015, the Addis Ababa Action Agenda of the Third International Conference on Financing for Development—attended by 193 UN member states—was authorized to provide funds for the data revolution for sustainable development. The Addis Ababa Action Agenda aims to support capacity building for knowledge and data sharing and technical assistance.[28] The Agenda recommends a variety of measures to embrace the data revolution and its benefits: creating a central, international data registry to improve transparency, providing data on aid effectiveness to demonstrate tangible results, and increasing the collection and analysis of disaggregated data for policymaking decisions.[29]

High-level Group for Partnership, Coordination and Capacity-Building for statistics for the 2030 Agenda for Sustainable Development (HLG-PCCB) provides strategic leadership for the improvement of statistical monitoring and reporting, a primary goal of SDG 17 on technology.[30] The HLG-PCCB developed the Cape Town Global Action Plan for Sustainable Development Data in January 2017, outlining a framework for country-led planning and implementation of statistical

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22. TFSCB Administration Unit, "Trust Fund for Statistical Capacity Building: Annual Progress Report, April 1, 2014—May 25, 2015," *World Bank*, May 2015.

23. "Strengthening National Statistical Systems to Monitor Global Goals," *Organization for Economic Cooperation and Development*, accessed July 7, 2017, https://www.oecd.org/dac/POST-2015%20P21.pdf.

24. Jeffrey D. Lewis, "Development Economics (DEC) Vice Presidency," *World Bank*, May 8, 2008, http://siteresources.worldbank.org/PSGLP/Resources/JeffreyLewis.pdf.

25. World Bank, *Atlas of Sustainable Development Goals 2017: From World Development Indicators. World Bank Atlas* (Washington, DC: World Bank, 2017), https://openknowledge.worldbank.org/handle/10986/26306.

26. "Strengthening National Statistical Systems to Monitor Global Goals."

27. Ibid.

28. "Addis Ababa Action Agenda of the Third International Conference on Financing for Development," *United Nations*, July 27, 2015.

29. Ibid.

30. "HLG-PCCB: High-Level Group for Partnership, Coordination and Capacity-Building for Statistics for the 2030 Agenda for Sustainable Development," UN Statistics Division, last accessed August 17, 2017, https://unstats.un.org/sdgs/hlg/.

capacity building to complete the 2030 Agenda. Key parts of the strategic plan include modifying laws and regulatory frameworks regarding national statistical systems, developing integrated national databases, comprehensively integrating geospatial data into statistical programs, and improving data and statistical transparency.[31]

While critical, these efforts must be coordinated closely and must not be the only avenues for harnessing the data revolution in the developing world. Innovations in data collection and interpretation present an opportunity to capture the needs and demographics of the developing world, give large and small businesses a more complete picture of their supply chains and their competition, and find solutions for development challenges.

OVERVIEW OF THE REPORT

This report is organized into six chapters, the first of which provides an introduction to the remaining five. Chapter 2 outlines the environment in which data collection and analysis, innovative technologies, and international development overlap, primarily through an exploration of the role of the SDGs in shaping the data revolution. Chapter 3 mainly explores the concept of enabling "leapfrog" data technologies, establishing a definition of the term and determining ways in which policy can lay the groundwork for and support "leaping frogs." This chapter also delves into several specific examples of technologies that support data collection and the formulation of policy based on data. This chapter mainly explores the concept of leapfrog data technologies, establishing a definition of the term and determining ways in which policy can lay the groundwork for and support leaping frogs. These technologies include satellite mapping and imaging, wearable technology such as Bluetooth-enabled jewelry, and cellular technology that, among other things, promotes mobile banking and cash transfer.

Chapter 4 provides case studies from two countries: Laos and Myanmar. In Laos, REDD+ and the Vientiane Bus Operation Optimization Project are examples of two projects that seek to overcome data gaps. REDD+ focuses on deforestation, and the Vientiane bus project tracks data on bus safety and reliability with the hope of increasing ridership and government revenue. Myanmar's Project for Development of a Comprehensive Disaster Resilience System and Collaboration Platform in Myanmar (SATREPS) partnership uses satellite data to track several indicators including infrastructure, traffic patterns, and flooding or mudslide risks.

Chapter 5 presents an analysis of challenges facing developing country governments for using data in policymaking, and Chapter 6 builds on this analysis to present recommendations to the international community for harnessing innovation and supporting the data revolution.

31. High-Level Group for Partnership, Coordination and Capacity-Building for Statistics for the 2030 Agenda for Sustainable Development, "Global Action Plan for Sustainable Development Data," *High-Level Group for Partnership, Coordination and Capacity-Building for Statistics for the 2030 Agenda for Sustainable Development*, October 21, 2016, https://unstats.un.org/sdgs/files/global-consultation-hlg-1/GAP_HLG-20161021.pdf.

02

The Data Revolution and the Sustainable Development Goals

The UN's SDGs build on the successes of the MDGs; they also learn from them. The 17 SDGs are characterized as a "universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity."[1] Due in part to the difficulty in collecting MDG-related data, Ban Ki-moon, then secretary-general, created an Independent Expert Advisory Group (IEAG) on a Data Revolution for Sustainable Development in 2014 to advise on how to realize the "revolution in data" he knew would be necessary to achieve the SDGs.

As was presented in Chapter 1, governments, companies, academics, and civil society actors have long been harnessing the power of data and evidence for use in decisionmaking. Indeed, a data revolution of sorts has been occurring for quite some time. However, whether for reasons of capacity or political will, decisions to allocate scarce resources to policies and services targeting poor people in developing countries are too seldom based on complete and accurate data. Starting in August 2014, the IEAG had a mandate to address the gaps; to make recommendations on how the international community might harness the data revolution for sustainable development purposes.

This chapter discusses the basics of the SDGs, how the IEAG recommended the international community harness the data revolution to achieve the SDGs, and the merits and repercussions of these recommendations. It examines steps by partners outside the official UN-driven sustainable data operation to capitalize on the data revolution and discuss the opportunities and challenges presented by an important entity responsible for progress on data: the GPSDD.

1. "Sustainable Development Goals," UNDP, accessed July 7, 2017, http://www.undp.org/content/undp/en/home/sustainable-development-goals.html.

BOX 2.1. Spending on Data for Sustainable Development

Meeting the SDGs requires data to help governments achieve progress *and* data to track the progress toward the 17 goals and 169 targets. Investment in both types of data is needed. The eight goals of the MDGs, created by the United Nations to drive targeted development in the first 15 years of the new millennium, did not emphasize increased evidence-based policymaking. The MDGs were also difficult to measure and resulted in uneven progress.[1] The SDGs build on the successes of the MDGs, but also seek to address a far broader range of issues than the MDGs. Gaps in data availability and accuracy—both to developing country governments and those tracking the MDGs more centrally—were a significant shortfall of the MDGs.[2] The SDGs specifically include a target on "data, monitoring, and accountability" as part of Goal 17, which focuses on strengthening the means for implementation. The Inter-Agency and Expert Group on SGD indicators has developed three indicators for this target.[3] Tracking the progress of the SDGs requires funding for data analysis programs, censuses, surveys, and technical training.

It is estimated that improvements in data collection and analysis would cost approximately $17 billion for the 77 poorest countries over the course of the SDGs (2016–2030).[4] If these 77 International Development Association (IDA)–eligible countries can cover half of these monitoring efforts, donors would be responsible for the remaining $550 to $600 million per year—the total aid required to support SDG data needs is estimated at $635 to $685 million per year through 2030. These estimates vary depending on the country—larger, more rural countries may have higher census costs, for example, than a highly concentrated urban country. Estimates of current commitments of required aid range from $250 million per year[5] to $470 million per year,[6] depending on what is included in the figure.[7]

The estimated costs do not include the additional costs of investing in education programs that would create a new generation of employees, officials, and citizens who are comfortable creating and interpreting data. A true, holistic "data revolution" would be more expensive than simply supporting the implementation of the SDGs and, importantly, would require integration with the broader educational development agenda.

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1. "United Nations Millennium Development Goals," UN, accessed July 7, 2017, http://www.un.org/millenniumgoals/.
2. Dimitri Sanga, "The Challenges of Monitoring and Reporting on the Millennium Development Goals in Africa by 2015 and Beyond," *African Statistical Journal* 12 (May 2011), https://pdfs.semanticscholar.org/5643/7109cf704c02e3b2f1c7c909c622ae28d36b.pdf.
3. "Revised List of Global Sustainable Development Goal Indicators," UN Statistics Division, accessed July 7, 2017, https://unstats.un.org/sdgs/indicators/Official Revised List of global SDG indicators.pdf.
4. "The State of Development Data Funding," Global Partnership for Sustainable Development Data, 2016.
5. Ibid.
6. "PRESS 2016: Partner Report on Support to Statistics," PARIS21, September 2016.
7. Arriving at clear figures of investment in statistical strengthening and data is challenging since many governments, donors, and project implementers include these components as part of broader-themed projects. Although they do exist, standalone initiatives on statistical strengthening and data are rare.

Figure 2.1. The Sustainable Development Goals

Source: UN Sustainable Development Knowledge Platform, accessed June 8, 2017, https://sustainabledevelopment.un.org/.

KEEPING TRACK OF THE SUSTAINABLE DEVELOPMENT GOALS

The SDGs were conceived at the UN Conference on Sustainable Development in 2012, even before final reporting on the MDGs.[2] After three years of deliberation and debate, the SDGs were adopted in late 2015 by 193 governments and a broad-based sustainable development movement of civil society, the private sector, and international organizations. The United Nations Development Programme (UNDP) states that the SDGs are a "bold commitment to finish what we started, and tackle some of the more pressing challenges facing the world today."[3] Practically the entire UN system is being mobilized to support SDG implementation, including the Economic and Social Council, one of the six primary organs of the United Nations. The High-Level Political Forum is the "central platform for follow-up and review of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals."[4] UNDP is one of many agencies directly responsible for

2. The SDGs are also known as the "Global Goals" or as the "2030 Agenda for Sustainable Development."

3. "Background of the Sustainable Development Goals," UNDP, http://www.undp.org/content/undp/en/home/sustainable-development-goals/background.html.

4. "High-Level Political Forum 2017," UN Sustainable Development Knowledge Platform, accessed July 7, 2017, https://sustainabledevelopment.un.org/hlpf

championing the SDGs, for funding projects to address the 17 various raisons d'être, and for scorekeeping progress. Assisting in the scorekeeping—or tracking of progress—is the UN Statistical Commission. It is a complex and multifaceted architecture that, in part, contributed to the challenge to keep score on the MDGs. This complexity is also a reason why a central scorekeeping and coordinating apparatus for the SDGs, like the independent Global Partnership for Sustainable Development Data in close cooperation with the UN Statistical Division, would be so valuable.

The SDGs address issues in a crosscutting, interconnected way, realizing that the pressing challenges facing those in the developing world also affect those outside it, that all countries need to adapt to meet the challenges we face, and that a siloed approach to problem solving is ineffective. Climate change impacts food security. Addressing gender inequality has poverty reduction implications. Social progress is tightly associated with national development.[5] Though admirable, this more collaborative approach, when presented in 2012, also raised significant data collection, utilization, and sharing questions.

The SDG commitment to the concept of "no one left behind" also necessitates broad capacity building to "increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics."[6] The SDGs implicitly necessitated—among other things like more funding for higher-quality surveys—the integration of new technologies to gather personal (e.g., mobile, smart card, and biometrics) and macro (e.g., satellite) data to ensure that no one was left behind in the SDG process.

Collecting accurate MDG data across 8 goals, 18 targets, and 48 technical indicators was challenging enough to warrant the reexamination of data improvement efforts. With 17 goals, 169 targets, and 232 indicators—all now mutually reinforcing and interconnected—it is not wonder why advisers to Secretary-General Ban Ki-moon envisioned that a revolution would be necessary to collect accurate SDG data.

Harnessing the Data Revolution

The term *data revolution* was coined in the 2013 report by the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, a group commissioned by Ban Ki-moon to help him think through the entire 2030 sustainable development agenda.[7] It called for "a data revolution for sustainable development, with a new international initiative to improve the quality of statistics and

5. Lant Pritchett, "Turns Out, Development Does Bring Development," Center for Global Development, accessed July 7, 2017, https://www.cgdev.org/blog/turns-out-development-does-bring-development.

6. "Resolution Adopted by the General Assembly: 70/1 Transforming Our World: The 2030 Agenda for Sustainable Development," UN, accessed July 7, 2017, http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E; *Transforming Our World: The 2030 Agenda for Sustainable Development: Sustainable Development Knowledge Platform* (Washington, DC: United Nations, 2017), https://sustainabledevelopment.un.org/post2015/transformingourworld.

7. High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development* (New York: United Nations, 2013), https://sustainabledevelopment.un.org/content/documents/8932013-05%20-%20HLP%20Report%20-%20A%20New%20Global%20Partnership.pdf.

information available to people and governments." As previously noted, this also led to the creation of the IEAG.

The IEAG realized that two things were occurring simultaneously: (1) there has been an explosion in the amounts of data collected in the last few decades with volumes increasing exponentially, albeit not uniformly across all countries; and (2) the demand for data from private-, public-, and social-sector entities has been increasing correspondingly. By these (admittedly incomplete) standards, a data revolution has been happening for decades, if not longer; it was time to bring the revolution into the sustainable development conversation. It was clear that this revolution was needed to achieve the SDGs, and that doing so would require the integration of new technologies and methodologies.

Globally, the types and volumes of data are indeed increasing rapidly. IBM, Google, SAS, Facebook, and other large, multinational companies think about big data as the "next frontier for innovation, competition, and productivity."[8] According to IBM, "we create 2.5 quintillion bytes of data" in a single day; at this rate "90% of the data in the world today has been created in the last two years alone."[9] The potential benefits of dividing these 2.5 quintillion bytes into more manageable, but still extremely large, data sets are huge, and our understanding of this potential is still evolving.

The *data* part of the data revolution is thus well understood. The possibilities are endless and exciting. What is less well understood is the "revolution" necessary to get us to inclusive growth in data collection and utilization. Current growth in these areas is vastly uneven. While companies like Facebook figure out ways to monetize large data sets, statistical agencies in developing countries like Myanmar grapple with "impossibly large stacks of paper on their desks instead of computers."[10]

Without focus—political commitment matched with investment—on capacity and infrastructure in countries like these, the paths of data revolution impact will diverge. In many cases, it is important to think of this as a multistep process beginning with building basic knowledge and awareness around the value of data followed by more specific focus on the various partnerships and opportunities around the world for building data utilization. Unlike the common perception of revolution as being relatively quick, broad, and transformational, the data revolution will be slow, context specific, and incremental. Building numeracy skills and trust in the accuracy of even the most basic data may bring revolution faster and more sustainably than the slickest example of cutting-edge data collection technology.

In this regard, it should be noted that knowledge and learning in a capacity development (CD) process have been "increasingly emphasized among scholars, development policymakers, and

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8. James Manyika et al., "Big Data: The Next Frontier for Innovation, Competition, and Productivity | McKinsey & Company," McKinsey Global Institute, May 2011, http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation.

9. "What Is Big Data?" IBM, March 2017.

10. Daniel Runde, "The Data Revolution in Developing Countries Has a Long Way to Go," *Forbes*, February 25, 2017, http://www.forbes.com/sites/danielrunde/2017/02/25/the-data-revolution-in-developing-countries-has-a-long-way-to-go/.

practitioners."[11] Stiglitz and Greenwald presented a systematic and holistic analysis of what constitutes a learning society, stating that "the most important 'endowment,' from our perspective, is a society's learning capacities."[12] As such, international cooperation for CD processes with a strong focus on learning and cocreation of knowledge or innovative solutions could be effective in creating learning societies, especially when combined with efforts to create local demand for the capacities.[13] This approach could be applied well to enhance capacities for harnessing data revolution through learning.

In places where the types and volumes of data are increasing—whether by advanced technology, increased skills, and/or accuracy of basic data—so too is the demand for them. As presented in Chapter 1, the use of evidence in policymaking is not a new concept. However, with new types and volumes of data increasing at such a rapid pace, companies and policymakers alike must decide how much time, effort, and resources to invest in understanding how best to utilize available evidence. Even if they can overcome budget constraints and other challenges (see Chapter 5), developing country policymakers must make decisions with limited technical knowledge and capacity. For example, Ministry of Public Works and Transport officials in Vientiane, Laos, have the budget and political will to procure a data-driven traffic management system; unfortunately, they do not have the capacity to decide which of the technologies regularly presented to them are appropriate for their needs.[14]

To its credit, the IEAG acknowledged that, despite a much more data-driven understanding of the developing world thanks to the MDG scorekeeping experience, "huge data and knowledge gaps remain."[15] In other words, there is a long way to go on this road to revolution. It is around the five points listed below that the IEAG recommended the United Nations—and the international community—spur the revolution to address the remaining data and knowledge gaps. That targeted, independent, and data-focused initiatives were proposed at all is notable and significant. Data capture and utilization traditionally had been an afterthought in the global sustainable development conversation; now it was elevated not just in the eyes of the private sector, but also on the agendas of those invested in the SDGs.

Realizing its possibilities and current global disparities in utilization, the IEAG recommended the following to the Secretary General in 2014:[16]

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11. Akbar Noman and Joseph E. Stiglitz, eds. *Efficiency, Finance, and Varieties of Industrial Policy: Guiding Resources, Learning, and Technology for Sustained Growth* (New York: Columbia University Press, 2017), chap. 10, http://www.jstor.org/stable/10.7312/noma18050.

12. Joseph E. Stiglitz and Bruce C. Greenwald, *Creating a Learning Society: A New Approach to Growth, Development, and Social Progress* (New York: Columbia University Press, 2014), https://cup.columbia.edu/book/creating-a-learning-society/9780231152143.

13. Noman and Stiglitz, *Efficiency*, chap. 10.

14. Key stakeholder interview.

15. Ibid.

16. "A World That Counts: Mobilising the Data Revolution for Sustainable Development," Independent Expert Advisory Group on a Data Revolution for Sustainable Development, November 2014, http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf.

1. Create a "Global Consensus on Data" to address concerns around legal, technical, privacy, geospatial and statistical standards.
2. Create a "Network of Data Innovation Networks" to share best practices regarding monitoring of SDGs.
3. Allocate new resources for capacity development, especially in low-income countries, aimed at addressing barriers between people and data.
4. Create a UN-led "Global Partnership for Sustainable Development Data" to mobilize and coordinate actors in this space.
5. Establish a "SDGs data lab" focused on visualizing and analyzing SDG data.

BOX 2.2. Breaking Down the IEAG Recommendations

The following paragraphs dive deeper into each IEAG recommendation, highlighting the potential—and potential limitations—of each.

(1) Any data scientist, economist, or regular user of Microsoft Excel can envision why the proposed "Global Consensus on Data" is necessary. "The world needs international norms and protocols to ensure the free flow of data."[1] Without universal statistical standards, it is difficult to imagine how UNDP could properly "keep score" at a country level, much less aggregate disparate data across countries. The Open Data Charter, a separate document agreed upon as part of a G8 agreement, listed as a core principal that data should be released in "convenient open formats to ensure files can be easily retrieved, downloaded, indexed, and searched by all commonly used Web search applications."[2]

In addition to the ability to aggregate data, making more data available carries with it significant legal, logistical, and privacy concerns. These concerns have not yet been addressed in a uniformly accepted way. These could be perceived to be only technical problems—and thus easily avoidable by political and policy discussions—when in fact legal and privacy issues, data ownership, and rights of individuals in these areas are highly political and often contentious topics. The data revolution would benefit from greater technical and political consensus around these issues. However, in recommending "that the UN develop a comprehensive strategy and a roadmap towards a new 'Global Consensus on Data,'" the IEAG identified a need (the consensus) without a specific champion within the UN system to drive the agenda.[3] As of March 2017, it appears that the newly created UN World Data Forum—and not the myriad other existing organizations listed in Appendix A—will serve as the de facto champion of this cause.[4]

(2) The proposed "Network of Data Innovation Networks" has at its core a realization that sharing information and best practices among the vast array of stakeholders is critical to achieving the scale necessary to report SDG progress. Since it is not only the *volume* of data but the *types* of data that are increasing exponentially, new knowledge-sharing platforms are needed to collect data and utilize it. Examples of this include the DATA4SDGS Highway initiative of the Global Partnership that

(*continued*)

BOX 2.2. (Continued)

encourages data interoperability and brings together more than 180 "champions globally representing the full range of data producers and users"[5] and the proposed UN-led Global Platform for Data, Services and Applications.[6] Other non-UN entities—like the OpenData500 Global Network[7]—have sprung up in the last five years with significant technical leadership from academicians and financial support from private foundations and governments alike. The independent Post-2015 Data Test initiative is attempting to "unpack the data revolution at the country level through an early examination of candidate post-2015 goals, targets and indicators."[8] Other independent initiatives like Data for Policy[9] and Evidence for Policy Design[10] highlight effective uses of data in policymaking while also serving as a forum for applications of data science in public policy. Though the United Nations and the independent Global Partnership could be networking leaders, the fact that there are an increasing number of other new networks signals broad acceptance of the need for greater data and best practice sharing.[11]

(3) In its call for increased funding for capacity development, it rightly points out that "strengthening national capacities in all areas from data production to use will be the essential test of any data revolution."[12] This is also the most difficult to implement of all the recommendations, given that capacities vary greatly and, unlike with the other recommendations, creating a separate organization to spearhead the effort is not appropriate nor called for. The IEAG report does call for increased focus on the following "pillars": investment needs; managing funds; private-sector participation; capacity development; and global data literacy. But in each one of these pillars the report notes the need for more analysis; this is because capacity development is a regional, country-level, and even local-level endeavor. Though there are some useful starting points—like the World Bank's "Capacity Development Results Framework" report from 2009[13]—the evidence on what works best in capacity development is mixed, further complicating program design. Furthermore, assessing results is challenging, as evidenced by the need for the 2009 World Bank report. There is no unified approach to keeping score on capacity-building exercises, making data collection, aggregation, and utilization a challenge (see *The Capacity Building Conundrum*). Nor is there an entity—like the Global Partnership—tasked with driving this agenda.

(4) The call for the creation of a "Global Partnership for Sustainable Development Data" has had arguably the greatest impact after the IEAG report. Although not the United Nations–led initiative originally envisioned by the IEAG, the Global Partnership was formed as an independent "global network of governments, NGOs, and businesses" with a mandate to "[catalyze] action to achieve sustainable development and pave a road to dignity for all using data." With significant non-UN funding complimenting its ongoing support to UN initiatives, a global network of over "150 data champions," and a broad mandate, the Global Partnership is well positioned to be a leader in the drive to harness the data revolution for sustainable development. The capacity of individual members to harness the data revolution exists, but they are stronger together as part of the Global Partnership that represents the first time that public-private partnerships on data are working together.

(5) In its fifth recommendation, the IEAG called for the establishment of a SDG Data Lab on the road to "some quick wins." In reality, the SDG Data Labs already exists, albeit in a smaller and less multilateral form than originally envisioned.[14] The SDG Data Labs is a project of a private company, iTech

BOX 2.2. (Continued)

Mission, founded in 2016 and is a similar social enterprise to the one that supported monitoring of the MDGs.[15] The quick wins mentioned by IEAG involve "developing an SDG analysis and visualization platform" and "building a dashboard from diverse data sources."[16] While data visualization is useful for contextualizing impact and condensing large data sets into digestible pieces, the more impactful element of the SDG Data Labs initiative is its focus on monitoring and analysis.[17] It is also not clear that an entity entirely separate from the other groups—especially the Global Partnership for Sustainable Development Data—is necessary nor efficient.

The stated goals of the Global Partnership[18] span almost the full range of other recommendations by the IEAG, from data principles and standards to technology sharing to stakeholder coordination and beyond. The only thing not covered fully is the mobilization of new resources specifically for capacity development, though its stated goals do endeavor to "[expand] data literacy and capacity."[19] It is here in the capacity development space that the greatest opportunity exists for the Global Partnership. If this expanded mandate also includes closer coordination with—or consolidation of—some of the functions currently led by other related yet separate entities (mentioned above), the Global Partnership for Sustainable Development Data could assume a key leadership role in, and have a transformational impact on, the data revolution.

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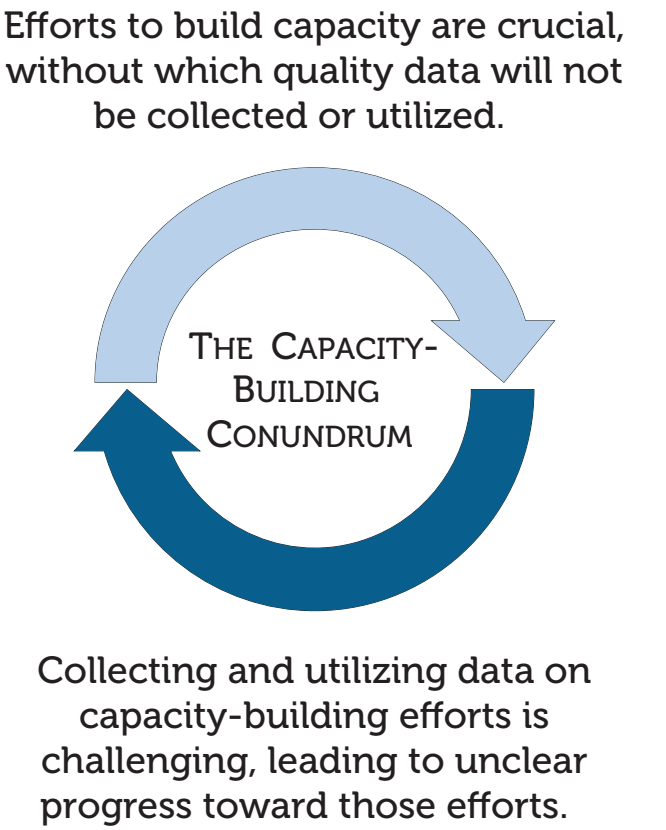
1. Susan Lund et al., "Defending Digital Globalization," Foreign Affairs, April 20, 2017, https://www.foreignaffairs.com/articles/world/2017-04-20/defending-digital-globalization.
2. "G8 Open Data Charter and Technical Annex," Gov.UK, accessed July 7, 2016, https://www.gov.uk/government/publications/open-data-charter/g8-open-data-charter-and-technical-annex.
3. "A World That Counts."
4. "UN World Data Forum," accessed June 8, 2017, https://undataforum.org/WorldDataForum/.
5. "Transform Data on SDGs into Effective Applications and Visualisations," Global Partnership for Sustainable Development Data, accessed, July 7, 2016, http://apihighways.data4sdgs.org/.
6. "Committee on Global Platform for Data, Services and Applications," UN Global Working Group for Big Data, accessed July 7, 2016, https://unstats.un.org/bigdata/taskteams/globalplatform/.
7. "Open Data 500," NYU Polytechnic School of Engineering, accessed July 7, 2016, http://www.opendata500.com/.
8. "The Project," Post 2015 Data Test, accessed July 7, 2016, http://www.post2015datatest.com/about/the-project/.
9. "Data for Policy," accessed July 7, 2016, http://dataforpolicy.org/.
10. "Evidence for Policy Design at the Center for International Development," Harvard University, accessed July 7, 2016, http://epod.cid.harvard.edu/home.
11. Appendix A and "Initiatives on the Data Revolution for Post-2015," UN Data Revolution, last accessed August 17, 2017, http://www.undatarevolution.org/catalog/2/ present myriad UN and non-UN groups working on these issues.
12. "A World That Counts."
13. Samuel Otoo, Natalia Agapitova, and Joy Behrens, "The Capacity Development Results Framework: A Strategic and Results-Oriented Approach to Learning for Capacity Development," World Bank, June 2009, https://openknowledge.worldbank.org/handle/10986/23037
14. Key informant interview.
15. "Who We Are," Global Partnership for Sustainable Development Data, accessed July 7, 2016, http://www.data4sdgs.org/who-we-are/.
16. "A World That Counts."
17. See SDG Data Labs, http://www.sdgdatalabs.org/monitoring/. Although the SDG Data Labs initiative utilizes specific software designed for this purpose, LogAlto, other similarly functional platforms—like Synergy International Systems and Kashana—exist.
18. "What We Do," Global Partnership for Sustainable Development Data, accessed July 7, 2016, http://www.data4sdgs.org/what-we-do/.
19. "Who We Are," Global Partnership for Sustainable Development Data, accessed July 7, 2016, http://www.data4sdgs.org/who-we-are/.

Figure 2.2. The Capacity-Building Conundrum



Source: Created by authors.

CONCLUSION

The conclusion of the MDG process leading into the formation and adoption of the SDGs created momentum to pursue a revolution in development data. The need for a data revolution was not only recognized at the highest political levels—notably through leadership of Ban Ki-moon, then secretary-general—but also by a diverse consortium of organizations and actors operating in development, technology, civil society, and other fields. This simultaneous top-down and bottom-up interest in harnessing the data revolution creates a unique opportunity for transformative change. At the same time, for this revolution to be fully realized, there needs to be thoughtful consolidation of the various initiatives around the world to avoid duplicative efforts, to reach agreement on global data standards, and to create synergistic efficiency. There also needs to be thoughtful and honest reflection, particularly on the "top-down" interest; many commitments have not been matched with resources yet. Political attention to data and evidence at all levels is uneven at best. For the data revolution to have a lasting impact in the developing world, this must change while promising "bottom-up" interest is building.

03

The Enabling Environment for Leapfrog Data Technologies

REVIEW OF NOTABLE ADVANCES IN DATA CAPTURE TECHNOLOGY INNOVATION

Increased volumes of data have sparked increasingly innovative data capture technologies. The now ubiquitous presence of event data recorders (i.e., "black boxes") in today's vehicles provides emissions, accident, and other data useful for policy reasons and for an auto company's bottom line. Airplanes outfitted with radar technology and lasers can measure Antarctic ice several miles thick at the same time it measures the shape and elevation of an ever-changing ice surface.[1]

In disconnected regions with inconsistent access to internet, mobile coverage, and electricity, even basic technologies can struggle to survive. Nevertheless, a variety of innovative technologies that capture and analyze data are already in use in the developing world. Some of these are invented or implemented by organizations in Japan, Europe, or the United States, but many originate in the developing world itself. Of particular relevance are advancements in satellite, wearable, and mobile technologies that could have a transformative impact on the ability to collect reliable sustainable development data.

Satellite Technology

Geographic Information Systems (GIS) and satellite Earth Observation (EO) tools can help understand environmental and geographic threats to developing countries. In Southern Vietnam, the European Space Agency (ESA) implemented satellite technology to map the Mekong River delta.[2] Urban areas, rice farms, and flooded areas were all recorded through satellite imaging. During

1. "East Antarctica Melting Could Be Explained by Oceanic Gateways," UT News | The University of Texas at Austin, March 16, 2015, https://news.utexas.edu/2015/03/16/east-antarctica-melting-may-be-explained-by-oceanic-gateways.

2. "EO Information Services in Support Of: Building Exposure Maps of Urban Infrastructure and Crop Fields in the Mekong River Basin," *EO World*, January 11, 2012, http://siteresources.worldbank.org/EXTEOFD/Resources/8426770-1335964503411/EOWorld_AnnexF_Mekong_WB-BBL_20120112.pdf.

extreme flooding, such as in 2001 and 2011, or extreme drought as in 2002, these maps could model predictions for deaths, property damage, and environmental and economic disruptions caused by the weather patterns. However, this technology still required fieldwork in order to independently verify the results of the satellite map.

ESA used a similar technology in Rio de Janeiro, Brazil, to model for natural disasters in the city.[3] The satellite images mapped land use (residential or commercial, for example) and the area's elevation, then modeled flood scenarios to determine how extreme flooding and landslides would impact the city. This information can be used to inform new urban development plans based on areas that were least damaged in the flooding scenario, to identify underutilized or vacant areas of the city, and to support emergency response in the event of flooding or landslides.

ESA and the World Bank cooperated in 2012 to map metropolitan areas of Delhi and Mumbai in India and Dhaka in Bangladesh to determine how the land is used, to identify the historical changes the cities have undergone in the last two decades, and to draw comparisons between these urban areas.[4]

JICA has partnered with the Japan Aerospace Exploration Agency (JAXA) to create an early warning system, known as the JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST), that monitors forest change of 77 countries, including the Amazon in Brazil and the Congo basin, to contribute to conserve tropical forests.[5] The JJ-FAST development is built on a success case of JICA's past project in Brazil to monitor tropical forests, which used ALOS satellite images to monitor logging. From 2010 to 2011, the Brazilian government with the support of the project detected more than 1,000 cases of deforestation or illegal logging. The JJ-FAST program includes capacity building through training courses in Japan as well as regional seminars. It seeks to improve governments' understanding of forestry issues and to enhance staff capacity to address these issues.[6]

Satellite surveys such as the ones presented here are more cost-effective than surveys conducted in person and can more quickly map large areas such as cities. They are also on the cutting edge of evolving from the periodic static snapshot model to near real time, innovative data capture tools that could contribute to various fields including, but not limited to, climate change response, agricultural innovation, disaster prevention and response, and marine resource management.

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3. "Assessing Rio de Janeiro Vulnerability to Natural Disasters: EO Information Products," *EO World*, March 5, 2012, http://siteresources.worldbank.org/EXTEOFD/Resources/8426770-1335964503411/CSW-WBRIO-2012-PRS-00936-SUR.pdf.

4. "Historical Assessment of Spatial Growth of Built-Ups in Metropolitan Areas of Delhi and Mumbai in India and Dhaka in Bangladesh," *EO World*, January 10, 2012, http://siteresources.worldbank.org/INTEOFD/Resources/EOWorld_Urban_BBL-10Jan2012-GISAT_v2.pdf.

5. "JICA-JAXA Forest Early Warning System in the Tropics," homepage, accessed July 7, 2017, http://www.eorc.jaxa.jp/jjfast/.

6. "Forest Governance Initiative," JICA-JAXA Forest Early Warning System in the Tropics, accessed July 7, 2017, http://www.eorc.jaxa.jp/jjfast/forest_governance_initiative.html.

Wearable Technology

Wearable technology—such as smart watches, adhesive monitors, or data-collecting jewelry—can be used to collect information and treat patients in the developing world. Sensor Technology and Analytics to Monitor, Predict, and Protect Ebola Patients (STAMP2) has been tested in the United States, and is now being tested by USAID in Liberia to address the Ebola outbreak.[7] STAMP2 collects data on its wearers—including body temperature, location, and heart rate, among other facts—and transmits information to physicians.[8] STAMP2 can be monitored by physicians outside the infected area, which prevents their contamination and the spread of Ebola.

A new wearable technology, Khushi Baby, stores babies' medical records in a digital necklace.[9] Successful field tests have been performed in India, where health care providers scanned in vaccination information from their smartphone into the necklace each time a child received vaccines.[10] Parents can then receive automatic updates from the health care provider when it is time for the next round of vaccinations.

Cellular Technology and Mobile Banking

The proliferation of cellular technology in the developing world has led to a series of innovations around mobile banking. M-Pesa, launched in Kenya in 2007, is a rudimentary but widespread digital money transfer application that uses only SMS technology.[11] Access to mobile transfers, in addition to other benefits, increased women's access to money, as they were able to request remittances from their husbands who had moved to urban areas.[12] Though not without their challenges,[13] digital transfers are less risky than some traditional methods of sending money and can help smooth otherwise uneven or uncertain income streams.

Mobile and Smart Card Technology

In Laos, a JICA project is focused on improving the bus operation system by monitoring continuous traffic volume and speed observations through smartphone Wi-Fi packet sensors (see Chapter 5's case study on Laos). By collecting and analyzing this information the bus company can

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7. "Scripps Wins USAID Grant to Monitor Ebola Patients with Medical Wearables," MobiHealthNews, February 12, 2015, http://www.mobihealthnews.com/40564/scripps-wins-usaid-grant-to-monitor-ebola-patients-with-medical-wearables.

8. "Harnessing the Internet of Things for Global Development," *International Telecommunication Union*, 2016, https://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf.

9. "Khushi Baby," homepage, accessed July 7, 2017, http://www.khushibaby.org/.

10. *Khushi Baby* (blog), accessed July 7, 2017, https://khushibaby.wordpress.com/.

11. "Using M-PESA," *Safaricom*, https://www.safaricom.co.ke/personal/m-pesa/getting-started/using-m-pesa.

12. "The Opportunities of Digitizing Payments," *World Bank Development Research Group*, August 28, 2014, http://documents.worldbank.org/curated/en/188451468336589650/pdf/903050WP0REPLACEMENT0Box385358B00PUBLIC0.pdf.

13. Some of the challenges that mobile bank transfer technology encounters include a lack of interoperability between transfer hosting applications and banks, lack of access to wireless networks, lack of physical infrastructure, and gender imbalances in technology ownership. To overcome these obstacles, governments should create a supportive regulatory environment that establishes what companies or banks can provide what services, focus on supportive infrastructure such as electrification and network connectivity efforts, and create incentives for cooperation between banks and digital service providers.

carry out its operation management more effectively, and provide feedback on the route plan. It is also possible that this information could be used to inform the urban transportation plan. This case provides a good example of the value of "small data." In addition, it is conceivable that providing this information to citizens could incentivize additional data openness and sharing. Similar efforts are being made in Myanmar SATREPS.

The collection of urban traffic data using IC card in Bangladesh is expected to provide insights into individual user's traffic trends as well as the whole urban traffic flow. By adding a shopping point with an IC card, it is possible to improve the added value of the IC card to the user. It is also possible that IC card information could be used for data visualization.

SUMMARY

The technologies presented above hold great promise and are already having an impact on the developing world. However, it is worth noting that the broadest, and arguably most impactful, proliferation of technology in the developing world is with ideas and gadgets that are often decades old. Whereas smartphones are the minimum standard in many places, they have yet to break into emerging economies at scale. Even when they exist, data network limitations or app download restrictions may hinder their full functionality. M-Pesa shows that basic SMS—a technology that came into prominence in the 1990s—has had a greater impact than more recently developed smartphone technology.[14] Although this example of technology lag deals with the mobile sector, the same can be said for other sectors.

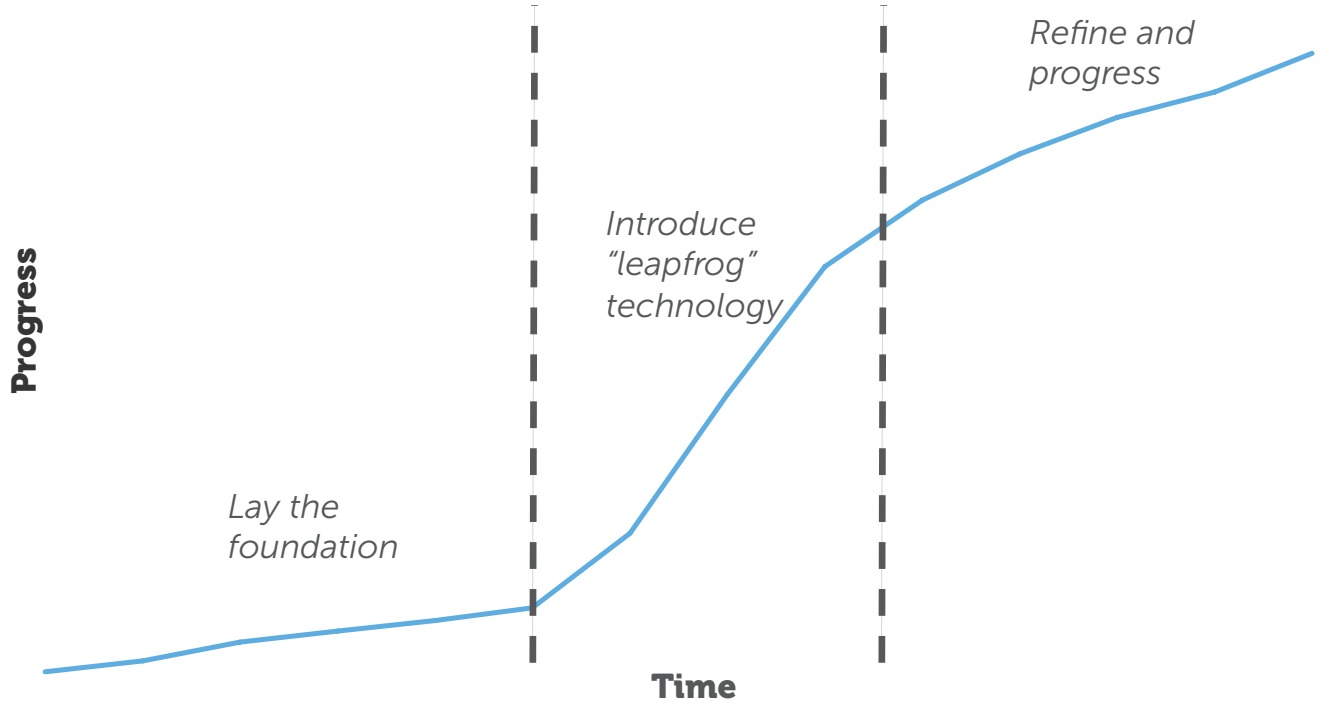
Technology transfer programs that identify, adapt, and deploy existing technologies in developing countries can deliver quick and significant returns. Ultimately, whether a technology—whether cutting-edge or decades old—succeeds in a developing country context depends critically on the foundational enabling environment in that country.

ENABLING FROGS TO LEAP

Three stages to capitalize on leapfrog data technologies are critical for success: laying the foundation for technology adoption, capitalizing on them when they are introduced, and then continuing to refine and progress. For the purposes of this report, *leapfrog data technologies* are defined as products, ideas, or refinements that have unprecedented impact potential in the relevant context. Meant to provide a theoretical framework, the learnings from this section could be relevant for data collection cost reduction, for greater proliferation of quality and useful data, for scaling up proven methods, or any number of additional topics each deserving further research and analysis.

14. Although on a path to convergence, mobile penetration in Kenya was 90.0 percent as of June 2016 ("Quarterly Sector Statistics Report Fourth Quarter for the Financial Year 2015–2016," Communications Authority of Kenya, September 2016, http://www.ca.go.ke/images/downloads/STATISTICS/SECTOR%20STATISTICS%20REPORT%20Q4%202015-2016.pdf) whereas smartphone penetration was around 44 percent (Consumer Barometer, https://www.consumerbarometer.com/en/).

Figure 3.1. Enabling Leapfrog Technology



Source: Created by authors.

Laying the Foundation

The existence—and nascent developing world deployment—of the technologies listed in the previous section is promising. However, the seemingly ubiquitous pursuit of "game-changing," transformational, or leapfrog data technologies often fails to acknowledge the foundation necessary for countries to capitalize on such innovations. This foundation looks different from country to country—as does the nature of leapfrog data technology—but most often consists of sufficient technical capacity, political will, and bureaucratic feasibility. These foundational elements of the policy enabling environment can take months, years, or even decades to materialize. Often it is incremental progress that leads to the development of this foundation, without which there is little room for leapfrog data technologies to flourish, refine, and grow (see Figure 3.1).

A core aspect of this foundation is the capacity of stakeholders to gather and utilize data. Although global discussions often revolve around big data or open data, the capacity of statistical agencies in countries like Myanmar and Laos to collect and utilize *any* data is rudimentary at best. Policy and politics play a big role in this data-less status quo as is discussed below; however, even the most effective enabling policy environment cannot compensate for a lack of capacity.

Thus, a focus on small data is paramount. Without mastering the basics, capitalizing on big or geospatial or other types of new data is difficult at best. Policymakers and bureaucrats require the basic data collection and analysis skills necessary to effectively deliver services. Burmese bureaucrats need to know how many women live in Shan Province, the education level of adults in Mandalay, and the malaria rates in Dawei—and how to effectively translate that information into

useful policy and services to citizens—before they can even think about big data or leapfrog data technologies. Nevertheless, some data technologies, like mobile phones, make accessing all data easier, faster, and cheaper. Although rare, such technologies could lower the threshold for usability and thus enable frogs to leap even without a fully formed foundation.

Along with the question of capacity comes the issue of how to lay a policy foundation that will allow leapfrog data technologies to flourish. This is a challenging question in part because different technologies require different levels of technical capacity to understand, political will to implement, and bureaucracy to navigate. Strong leadership is critical to ease entry and create demand. Required regulatory reform varies greatly from country to country and even from one region to the next within countries. Nevertheless, the "basic goal of regulatory reform is to create a stable, open, and future-proof environment," including "encouraging market-based approaches and ease of market entry; promoting business confidence and clarify; enhancing transactional enforceability; ensuring interoperability (of systems, standards, networks, etc.); and protecting intellectual property and consumer rights."[15]

Laying the foundation for an enabling policy environment is also difficult because agreeing on the requisite core ingredients—and what to do about them—often demands introspection and ultimately change. Governments are often passive in change. They have difficulties articulating demand and making the business case to constituents, their own organizations, or colleagues in government. They get mired in having done things a certain way for so long, otherwise known as being caught in a "capability trap." Capability traps hinder or reverse foundation-laying progress; when caught in one, policy implementers "cannot perform the tasks asked of them, and doing the same thing day after day is not improving the situation; indeed, it is usually only making things worse."[16]

Some leapfrog data technologies are deployed and adapted for effective use in developing countries despite the lack of a foundational enabling policy environment and baseline levels of capacity. However, these cases are few, moreover insufficient capacity has the possibility to be a barrier to sustainable growth and future impact. The leapfrog data technologies require Capacity for success. On the contrary, transformative technologies succeed more often when governments acknowledge the leapfrog potential, ensure the minimum necessary protections (for example to consumer privacy) are met, and then get out of the way.

Policymakers also have the potential to become a barrier to the adoption of leapfrog data technologies. For example, a developing county's government might be hesitant to collect more data about deforestation in their country if they think the collected data could harm their reputation and negatively affect private investment or development funding. Similarly, a developing county's government might claim to be protecting personal information when not collecting or sharing census data, but the reality might be that the government is wary of what it would find with improved statistics. Despite realizing that both deforestation and census data could be valuable in policymaking, in the minds of individual officials the downside risk is not worth the potential gain.

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15. Robert Schware, ed., *E-Development: From Excitement to Effectiveness* (Washington, DC: World Bank, 2005).

16. Matt Andrews, Lant Pritchett, and Michael Woolcock, *Building State Capability: Evidence, Analysis, Action*, 2017, http://dx.doi.org/10.1093/acprof:oso/9780198747482.001.0001.

On the other hand, governments can also play a catalytic role, removing barriers to entry and reducing risk to first movers. In the state of Gujarat, India, policymakers have created a series of partial or wholly government-funded technology incubators, encouraging risk and facilitating technology commercialization. Supported by the former governor of Gujarat and now Indian prime minister, Narendra Modi, the government at all levels has not only acknowledged the transformative potential of technology and created a conducive policy environment, it is actively breaking down barriers to entry. Not known for producing leapfrog technologies—especially when compared with Bangalore aka the Silicon Valley of India—Gujarat has nonetheless built a solid foundation over time on which transformative data technologies can grow.

Capitalizing on the Leaping Frog

It is important to note that the simple existence of an enabling de jure policy does not automatically mean that de facto the policy will be implemented. Reality is often very different from what is prescribed in policy, and policies are only as good as the capability for implementation allows. Thus, after the creation of an enabling foundational environment, implementation matters. "If whether a policy, program, or project [the three Ps] produces the desired outcomes hinges on how well it is implemented, then the real determinant of performance is not the three Ps but capability for implementation."[17] In some cases, this implementation involves getting out of the way; in others, it requires paving the way.

In 2010 the Department of Transport and Communications in Manila sought ways to "dramatically improve traffic flows, improve road safety, and more efficiently meet demand for services," despite not having a single map of the public transportation network in the city of 12 million people. With the support of the World Bank—and with a specific federal mandate to improve the transportation system—the Department upgraded traffic management and accident recording systems using geo-referencing and automation technologies.[18] It also created an Open Data Portal that increases transparency and produces "tremendous economies of scale in terms of applications and analyses that are derived from these data." Admitting to poor planning, an incoherent public transportation, and bad traffic problems carried with it significant political risk for the government; it decided to proceed nonetheless.[19] Now, having created the necessary enabling policy environment *and* baseline level of capacity and technology infrastructure, the city is in the process of deploying leapfrog data technologies—like powerful yet inexpensive cellphone data capture tools—that will transform the urban transportation landscape and ultimately save lives.[20]

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17. Ibid.

18. "Philippines: Real-Time Data Can Improve Traffic Management in Major Cities," World Bank, April 5, 2016, http://www.worldbank.org/en/news/press-release/2016/04/05/philippines-real-time-data-can-improve-traffic-management-in.

19. "Philippines: First Metro Manila Bus Rapid Transit Line to Benefit Thousands of Commuters Daily," World Bank, March 16, 2017, http://www.worldbank.org/en/news/press-release/2017/03/16/philippines-first-metro-manila-bus-rapid-transit-line-to-benefit-thousands-of-commuters-daily.

20. "5 Q's for Transportation Economist Holly Krambeck," Center for Data Innovation, March 6, 2014, https://www.datainnovation.org/2014/03/5-qs-for-transportation-economist-holly-krambeck/.

These examples—and many others leveraging existing and future leapfrog data technologies—have great potential to transform the availability and use of evidence in policymaking in the developing world. Technology adoption also requires increased capacity, a positive development outcome on its own. However, without implementation of the enabling environment, even the best laid plans are destined to fail.

Continuing to Refine and Progress

Implementation of the enabling environment does not end with the adoption of a leapfrog data technology. New, complementary, or supplementary technologies will emerge. Better processes will improve efficiency, reduce costs, and increase effectiveness. A quality enabling environment not only facilitates the implementation of a leapfrog data technology, it embeds—or future-proofs—progress into the natural policy environment. Future-proofing is particularly important because successfully doing so facilitates future technology adaptation while protecting advances already achieved. In other words, policies that do not create space for future innovation and refinement, or that are subject to shifting short-term political agendas, will inevitably face challenges.

The process above (and visually demonstrated in *Introduction of Leapfrog Technology*) is presented linearly and in two dimensions for demonstration purposes only. Rarely are the stages of capacity development and adaptation of leapfrog data technologies so clean and linear. Rarely does the enabling policy environment involve a single policy actor. Technology adoption and the creation of an enabling policy environment often involve months, years, or even decades of incremental change, policy tweaking, slow but steady capacity development, and even periodic regression. In some cases, the leapfrog data technology is more a methodological improvement than a winner of a global innovation prize. For example, the use of inexpensive, easy-to-use tablets with offline survey software—like SurveyCTO[21]—could have greater long-term impact on the ability of governments to improve lives via data-driven policy than the winners of any number of global data and technology prizes. In all cases, progress is challenging.

Ultimately, as we will see in Chapter 4, progress can be achieved even without a fully developed foundation. Both Laos and Cambodia provide interesting examples of effective—albeit incomplete—enabling environments that have allowed leapfrog data technologies to succeed. As technological advancement and political will converge to drive forward a revolution in development data there will be many opportunities for developing countries to drive progress and build a better future.

CONCLUSION

A broad array of data technologies—including satellite and space-based observation, sophisticated wearable devices, and globally ubiquitous cellular phones—are increasingly accessible and affordable for developing countries, opening new doors for policymakers. It may not be necessary for developing countries to follow a linear progression of development laid out by OECD countries if

21. "Offline Mobile Data Collection," SurveyCTO, accessed July 7, 2017, http://www.surveycto.com/index.html.

they successfully deploy leapfrog data technologies that vault them forward several steps on the development continuum.

Deploying and utilizing new data technologies, however, is not as simple as copy and paste. In many cases, bureaucratic inertia, political sensitivities, and risk-averse officials can stymie innovation. Additionally, developing countries need to build domestic capacity to use and maintain new technologies, understand and analyze the data collected, and identify and implement change based on that analysis. This process of introspection and subsequent action is difficult for most governments. It involves an assessment of technical ability, political momentum, and organizational feasibility. Overcoming these barriers will require clear demonstrations of the benefits offered by leapfrog data technologies to encourage adoption alongside capacity-building efforts to ensure the benefits of the new technology are fully realized.

04

Country Case Studies

CASE STUDY: LAOS

BOX 4.1. Main Takeaways

- Data collection and implementation requires increased capacity in government, as well as increased enforcement of existing data laws and regulations. Capacity-building and training programs are crucial to support the next generation of data scientists and users.
- Currently, there is not the domestic capacity to administer even relatively basic data-driven projects. For example, maintaining the sensor equipment in the Vientiane bus project is a significant challenge.
- The Vientiane city bus project has significant government support—vehicle accidents are a major concern and cause significant risk to citizens. Greater bus system efficiency is a priority. Collecting data on bus safety and reliability could save the city money and encourage ridership, both of which may cut down on traffic accidents.
- The bus project is operationalized through two SMEs—Japan Research Institute for Social Systems (JRISS) collected traffic data from user smartphones,[1] while Eagle Bus uses bus sensor data to inform enterprise management[2]—that were able to leverage new technologies to improve bus efficiency and service.
- REDD+ focuses on deforestation. With high research costs and limited political support, REDD+ may experience more limited success but still provides a useful example of leapfrog data technology in action.

1. Project name: "Verification Survey for New Location Information System and Traffic Observation System for Urban Transport Improvement in Vientiane City."
2. Project name: "Verification Survey for the Bus Operation Optimization System."

Background

The Lao People's Democratic Republic (Laos) sits between Thailand and Vietnam in Southeast Asia. A French protectorate until 1945, Laos was briefly occupied by the Japanese before returning to French rule. Shortly after gaining independence as a constitutional monarchy in 1954, Laos suffered through a civil war between royalists and Pathet Lao, a communist group. The civil war and its proximity to North Vietnam caused Laos extensive damage during the Vietnam War. By some estimates, more bombings occurred in Laos during the 1960s than during the entire Second World War.[1]

A cease-fire in 1973 led to a divided Lao government with the presence of both communists and royalists. Two years later, the Pathet Lao, which was renamed the Lao People's Front, seized power and declared the Lao People's Democratic Republic with only one legal political party. Communist reforms did undue damage to the country with food shortages and thousands of refugees fleeing to Thailand. This turmoil caused the country to allow some limited private enterprise in agriculture and, later in 1986, institute market-oriented reforms to match those of Mikhail Gorbachev in the Soviet Union.

Since the collapse of the Soviet Union, Laos has reaffirmed its commitment to communism—and remains one of the few one-party communist states—but has also become economically connected to the West and Japan.[2] In 1995 the United States lifted its 20-year aid embargo on the country; Laos has a population of just over 7 million people, more than 50 percent of whom are under the age of 25.[3] Laos joined the Association of Southeast Asian Nations (ASEAN) in 1997 and the World Trade Organization (WTO) in 2013.[4] 2000 saw the Laos government begin a decentralization process, which gave provinces more autonomy in budgeting and policymaking.

Laos' economy is supported mostly by the export of natural resources; logging, mining, and processing are major players in the Laotian economy, and often draw criticism for their environmental impact. Hydropower generated through dams along the Mekong River is also a significant component of Laotian GDP. In the past decade, Laos has been the recipient of major loans from the IMF and the World Bank, which have focused on electricity production and poverty reduction.

Data and Statistics

Progress toward SDGs is a key government priority as is its graduation from the UN Least Developed Country list where it has held a place since the inception of the list in 1971.[5] To that end, a

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1. "Laos Profile - Timeline," BBC News, January 11, 2017, sec. Asia, http://www.bbc.com/news/world-asia-pacific-15355605.

2. "Laos | History, Geography, & Culture," *Encyclopedia Britannica*, https://www.britannica.com/place/Laos/The-Lao-Peoples-Democratic-Republic.

3. "The World Factbook: Laos," Central Intelligence Agency, last updated August 1, 2017, https://www.cia.gov/library/publications/the-world-factbook/geos/la.html.

4. Ibid.

5. "List of Least Developed Countries," *United Nations Committee for Development Policy*, May 2016, http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf.

2010 Lao Statistical Law formalized data and statistics as government priorities.[6] Before the law was passed, the official statistics bureau was limited to being a 'center' rather than a high-level space for more established data collection. Recently, the Lao Statistics Bureau (LSB) organized a midterm review of its national strategy on national statistical systems (NSS). The midterm review was to improve the work of the LSB by improving data collection.[7] However, ministries, provincial and district governments do not adhere to the requirements and standards of the NSS, and the NSB remains understaffed.[8] Currently, it is estimated that 150 people in Laos are currently working in data collection and analysis.[9] In order to scale up the number of data analysts in the next generation, the MBA in National University of Laos set a course on statistics.[10]

Key Challenges to Using Evidence in Policymaking

The use of evidence in policymaking requires adequate capacity, an enabling bureaucracy, and the political will to use and share data. These elements exist in varying degrees in Laos depending on the sector; however, the country has a long way to go before it can start thinking about taking advantage of big data, the data revolution, and other elements of sustainable development data.

While Laos has a series of higher order capacities it must strengthen before it can leverage the coming data revolution, it must also strengthen some of its basic capacities. In particular, basic literacy and numeracy serve as the foundational skills for any subsequent data analysis. Repair and maintenance of technology has been an issue and only 18–20 percent of Lao people can access the internet. In rural areas, data acquisition and aggregation are still limited by the fact that data records are in paper form.

The availability of statistics still requires governmental staffers, especially at the provincial level, to understand how to use applied statistics. This is a means to guard against erroneous data reporting. The fact that the format for data collection is not standardized, at all levels of authority, means that it is difficult to aggregate data and draw meaningful conclusions. Delays in aggregation mean that sectors cannot get data on a monthly or quarterly basis, making data publication irregular which also harms its legitimacy.

Overall, collecting and disseminating accurate data in Laos is a challenge. Despite the legal framework provided by the aforementioned 2010 statistics law, continued lack of staff, overall staff capacity, complicated bureaucracies, and political will to share and utilize data in policy all present challenges for Laos.

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6. "Statistics Law," *Lao National Assembly*, June 30, 2010, http://adp.ihsn.org/sites/default/files/statistics_law_2010eng.pdf.
7. "Laos Conducts Mid-Term Review of SDNSS," PARIS21, accessed July 7, 2017, https://www.paris21/org/Laos-Conducts-Mid-term-Review-of-SDNSS.
8. "Country Analysis Report: Lao People's Democratic Republic," United Nations in the Lao PDR, accessed July 7, 2017, http://www.la.undp.org/content/dam/laopdr/docs/Legal%20Framework/UNDP_LA_CAR_2012_2015.pdf.
9. Key stakeholder interview.
10. Key stakeholder interview.

KEY DATA PROJECT OVERCOMING THESE CHALLENGES: VIENTIANE BUS OPERATION OPTIMIZATION PROJECT

Background and Key Operating Details

The Vientiane Bus Project, supported predominately by JICA, sought to collect data on city bus routes, passengers, safety, and efficiency. The project began in 2012 when JICA provided 42 buses to the Vientiane Capital State Bus Enterprise (VCSBE).[11] In 2016 JICA installed data collection devices in each bus that count passengers, provide GPS tracking technology, and take pictures. In the future, VCSBE hopes to install fuel sensors as well.

The project aims to help the VCSBE and ministry officials better understand current bus usage, identify inefficiencies, and ultimately design improvements in the Vientiane city bus system. The data collected, which are currently stored in Japan, will be run through an optimization program that diagrams inefficiencies. VCSBE employees will be trained to use this analytic tool, as well as other methods for identifying and eliminating waste in the provision of public services.

JICA provided 42 buses in 2012, and from 2011 to 2015 implemented a Technical Cooperation Project. The project has an initial focus on organization management. Projects were carried out by two Japanese small and medium-size enterprises.[12] In 2015 and 2016 information including bus location and traffic analysis was collected by Wi-Fi packet sensor (please refer Chapter 3). Bus operation management using ICT became the focus from 2016 to 2017, a process which is still in progress.

Beginning in 2016, this SME led project shifted into its second phase with a focus on operation and management technology cooperation. Additionally, higher-level measures such as urban transportation planning and traffic demand management will be implemented through this project. The Ministry of Public Works and Vientiane City will also join the project as direct counterparts instead of as supervising organizations. This change was prompted by greater awareness on the part of the Laotian government when it comes to the significance of data utilization. This was a lesson learned through the JICA-supported SMEs projects.

The following shows the contents of one of two projects implemented by the SME, Eagle Bus Company. The other project is reviewed in Chapter 3.

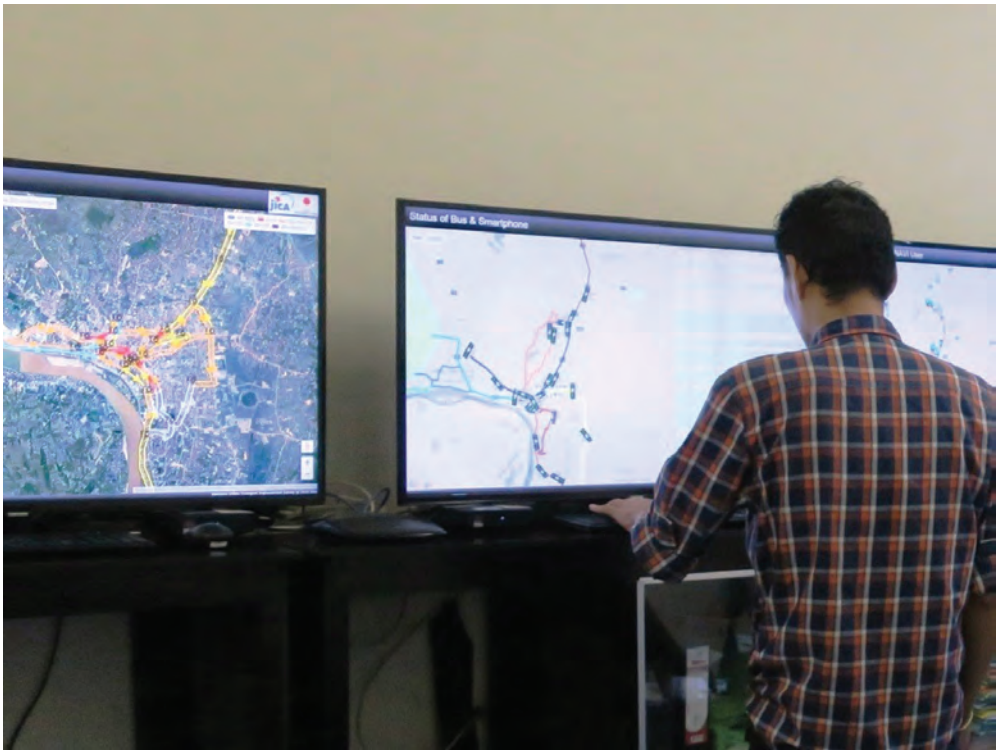
The bus project hopes to begin to correct the following specific issues with the Vientiane city buses:

1. *Bus routes.* Buses do not always carefully follow their designated bus routes, and bus drivers do not always stop at designated bus stops. GPS and imaging technology will help

11. Grant Aid: The Project for Improvement of Transportation Capacity of Public Bus in Vientiane Capital (2011.3). Technical Cooperation: Project to Enhance the Capacity of Vientiane Capital State Bus Enterprise (2012.1-2014.12).

12. Grant Aid: The Project for Improvement of Transportation Capacity of Public Bus in Vientiane Capital (2011.3). Technical Cooperation: Project to Enhance the Capacity of Vientiane Capital State Bus Enterprise (2012.1-2014.12).

Figure 4.1. The Control Monitors in Vientiane Bus Location System Control Center



Source: Photo by Japan Research Institute for Social Systems, used with permission of license holder.

determine if buses follow accurate routes through Vientiane. This technology provides an accountability mechanism to ensure that drivers show up on time, work their entire shifts, and follow the appropriate routes. In the long term, the large-scale collection of data from the entire bus system will help provide insights on potential improvements on route selection, running times, and so on.

2. *Idling.* Buses in Vientiane can be left idling for long periods of time, costing the city up to US$13 million per year.[13] GPS tracking and fuel monitoring could determine which buses are idling and why. Reducing idling has a direct impact on fuel cost savings, but could also help improve local air quality through reduced emissions. Vientiane has been noted for its deteriorating air quality in recent years, a trend that has long-term negative effects on public health and the environment.[14]
3. *Safety.* Driving with the door open, speeding, ignoring traffic laws, and other safety concerns are common in Vientiane. Traffic accidents caused more than 1,000 deaths last year in Vientiane. As the roads become increasingly congested—with a 15 percent increase in

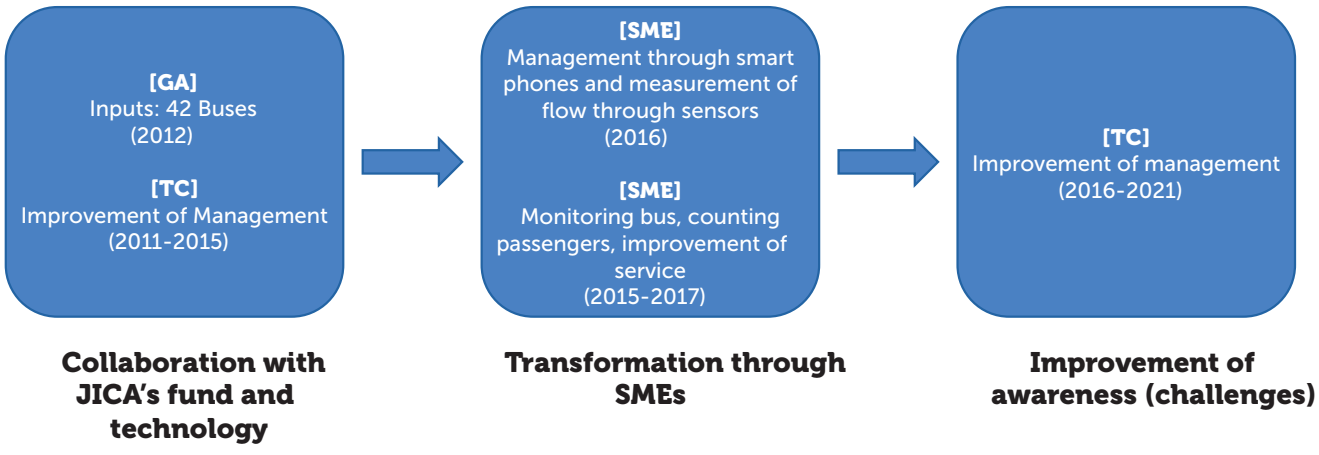
13. Key stakeholder interview.

14. "Lao People's Democratic Republic: Vientiane Sustainable Urban Transport Project," Asian Development Bank, accessed April 27, 2017, https://www.adb.org/projects/45041-002/main.

Figure 4.2. The Public Bus provided by JICA to the Vientiane Capital State Bus Enterprise (VCSBE)

Source: Photo by Japan Research Institute for Social Systems, used with permission of license holder.

Figure 4.3. The Flow of JICA's Laos Bus Projects: How It Changed from Phase 1 to Phase 2



Source: Created by authors.

Figure 4.4. The Prospected Outcomes of JICA's Laos Bus Projects (Phase 1)

Outcome 1: Improve the bus company's corporate management
• Improve financial situation (medium-term management plan, record system)
• Operation, vehicle maintenance, training
• Vehicle operation and management equipment facilities
• Social experiment of public bus transportation
Outcome 2: Improve public corporation bus service based on citizens' request
• Establishment of transport committee, collection of opinions, and requests of citizens
• Bus service criteria, setting of service standard
• Planning and review of bus stop position and improvement of bus service
Outcome 3: Plan the public transport policy and bus transportation
• Fair billing and subsidy policy
• Formulation of medium bus midterm traffic plan, renewal of plan
• Complementary system with para-transit
• Bus transportation preferential measures (illegal parking control)

Source:Created by authors based on JICA Pre-Implementation Stage Evaluation on the Project to Enhance the Capacity of Vientiane Capital State Bus Enterprise (Phase I); see https://www2.jica.go.jp/ja/evaluation/pdf/2011_1000231_1_s.pdf.

vehicles annually—decreasing traffic-related mortality rates is a government priority.[15] Monitors in buses that track GPS, speed, and take photographs of bus interiors could reduce or at least identify safety violations.

4. *Increasing ridership.* The Vientiane city government believes that students make up the largest proportion of bus riders; a more accurate tracking method for passengers would

15. Key stakeholder interview.

Figure 4.5. The Prospected Outcomes of JICA's Laos Bus Projects (Phase 2): Change from Phase 1 to Phase 2

Outcome 1: Strengthen the operational structure of the bus company
• Financial improvement, improvement of management system and capacity building, self
• Strengthening of operating system and utilization of ICT
Outcome 2: Improve the bus service
• Creating operation schedule and its data collection and fare system
• Safety, bus operation to fit citizens' needs, reconsideration of operation plan and bus stops
• Bus service information provision and public relations
Outcome 3: Improve the necessary public bus transportation policy
• Subsidy and exemption system
• Traffic demand management plan, traffic policy plan, establish Ministry working group, city and bus enterprise
• Mobility management services
• Sharing with para-transit, public bus priority measures

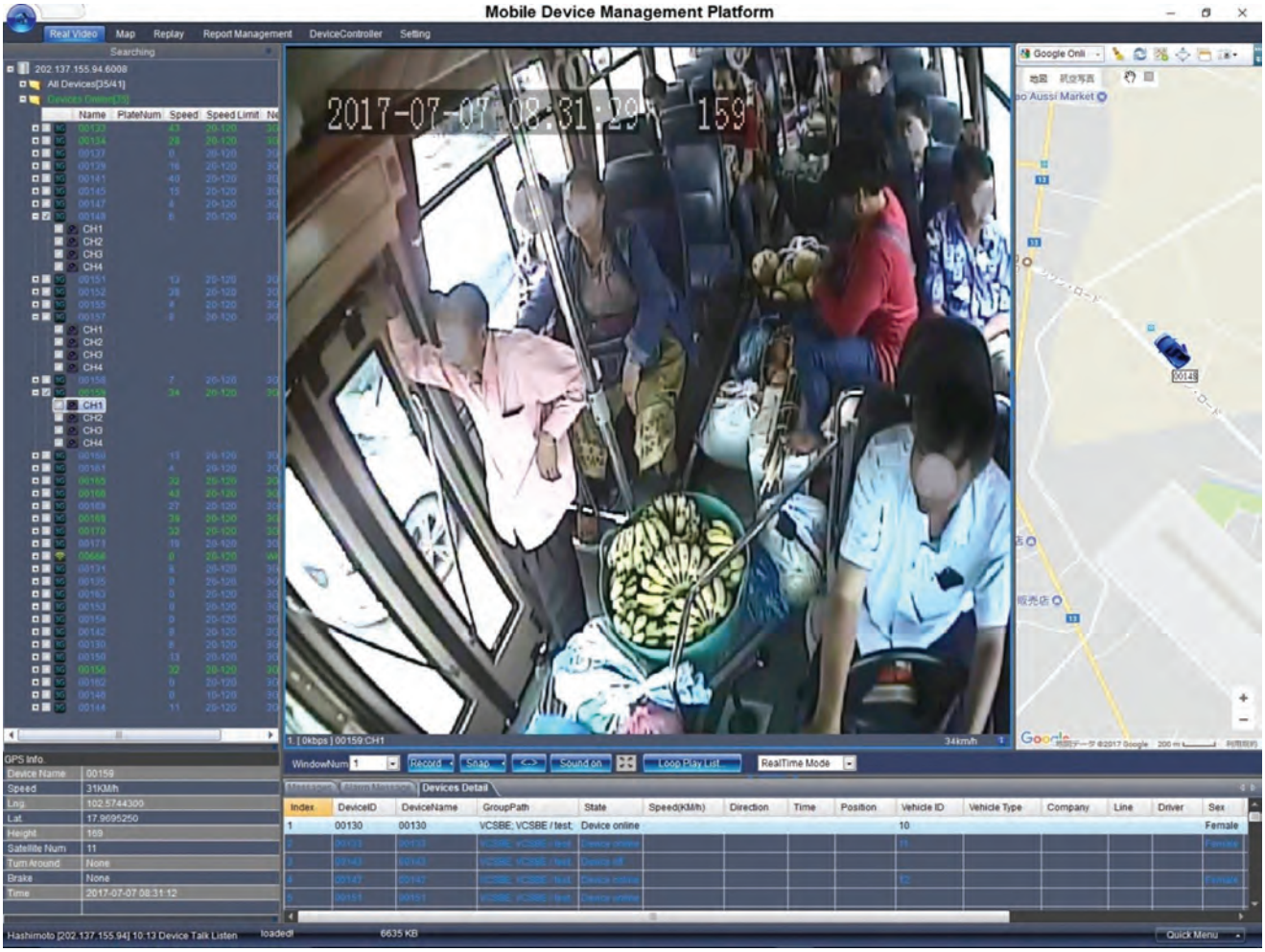
Source: Created by authors based on JICA Pre-Implementation Stage Evaluation on the Project to Enhance the Capacity of Vientiane Capital State Bus Enterprise (Phase II); see https://www2.jica.go.jp/ja/evaluation/pdf/2015_1500232_1_s.pdf.

determine if this is true.[16] More broadly, there is an imperative to increase the utilization of public transport in Vientiane. Private vehicle registration increased at an average rate of 17 percent annually from 2000 to 2009, and has averaged more than 10 percent growth each year since then. Reducing the number of private vehicles on the road would reduce congestion and ease the burden on Vientiane's already overwhelmed transport infrastructure. Currently, only 0.6 percent of all daily trips occur on public transport.[17]

16. Key stakeholder interview.

17. "Lao People's Democratic Republic."

Figure 4.6. Mobile Digital Video Recorder (MDVR) Monitoring System and Bus Location System



Source: Photo by Eagle Bus Co., Ltd., used with permission of license holder.

5. *Saving money, generating revenue.* In general, VSBE officials and local government ministries are looking to cut back on the costs of public transportation. Just as idling buses cost the city unnecessary fees, creating a more efficient transportation system would save money. Even more than money saving, public transportation fees can also provide a source of government revenue. Increased ridership would directly strengthen the government's financial position.

Successes in Achieving Its Mission

The bus project is relatively new, and while the bus sensors have yet to produce policy changes, the partnership between JICA and VCSBE has already created positive returns for the city of Vientiane. Ministry officials are studying traffic management in Japan, and can return to Vientiane to educate their colleagues.[18] Additionally, the project is likely to have a large impact on the urban

18. Key stakeholder interview.

poor who would not otherwise have affordable transportation within the city, limiting their access to employment and other opportunities.

A partnership between VCSBE and the state-owned telecom company may also begin as a result of the needs of the bus project.[19] Improving the mobile network would improve data collection accuracy for the bus monitoring equipment, and could result in more complete coverage for all cell phone users in the city. Through this partnership there is also the potential to identify new opportunities similar to the bus project where mobile data could be leveraged to improve the provision of public services.

If the VCSBE and other government officials see the bus project as a success, it could serve as justification for additional investments in data collection, management, and analysis. While most of the financial support for the project has come from JICA so far, the hope is that by demonstrating value the project will lead to further investment from the Lao government. Particularly in countries and regions where data collection and capacity are low, it is important to provide clear examples of positive returns on investment in data projects. This can help build a cultural foundation for the use of data- and evidence-based policy and decisionmaking and spur further investment. Despite being a bus project, the city and the Ministry of Public Works have participated. In this way, the project helped address the larger urban transport problems and changed public transportation using bus data.

Challenges in Achieving Its Mission

One significant challenge of the bus project is the maintenance and repair of the bus sensor hardware.[20] Without appropriate training, experts in Vientiane would be unable to provide maintenance for the sensors. Buses were only equipped with data collection devices in 2016, but maintenance has already emerged as a key issue in the program's sustainability.

Another challenge is the upkeep and storage of the data generated by the sensors. Currently, the data is housed in Japan, but when the funding for this project expires in 2019, the Lao government will need to be able to store and interpret the data without Japanese assistance.[21] JICA is currently training officials to assist with this transition.

The upside to both of these challenges is that they provide clear employment opportunities for workers in Laos. Maintaining the bus sensors and hardware, in particular, could provide work opportunities for training of ultimately skilled workers. Similarly, using Laotian workers to manage data upkeep and storage is an opportunity for internalize new capacities into the government. Laos will require technical assistance and training before it is capable of managing these processes itself, but donors like JICA are already stepping in to help with necessary workforce development and skill building.

19. Key stakeholder interview.
20. Key stakeholder interview.
21. Key stakeholder interview.

BOX 4.2. Improving Bus Operation in Phnom Penh

The Project for Improvement of Public Bus Operation in Phnom Penh (PiBO Project) is similar to the bus project in Vientiane, Lao PDR, with JICA working to provide public bus service in Phnom Penh, Cambodia, and reduce traffic congestion and accidents. The grant agreement was signed on November 30, 2016, and JICA will provide approximately US$12.5 million to procure 80 buses for the city. Phnom Penh will expand the current 3 bus routes to 10 routes by 2020.[1]

Like many cities in Southeast Asia, Phnom Penh has experienced rapid population growth in recent years. Cambodia's urban population, the vast majority of which can be found in Phnom Penh, increased from 0.9 million in 2000 to 1.4 million by 2010.[2] According to JICA's projection, Phnom Penh's rapid growth will continue in the coming decades, and the population in Phnom Penh will nearly double by 2035.[3]

In line with this rapid population growth, a significant increase in the number of vehicles is observed on the road. This trend will continue as the economy in Cambodia grows and motorcycles, cars, and other vehicles are more affordable for the citizens in Phnom Penh. According to the Ministry of Public Works and Transport, the total number of registered vehicles in

Figure 4.7. The Public Bus in Phnom Penh

Source: Photo by JICA, used with permission of license holder.

(*continued*)

BOX 4.2. (Continued)

Cambodia increased 15 percent between 2013 and 2014, and motorcycles increase more rapidly.[4]

The government recognizes the rapid urbanization and associated urban transport issues such as congestion, accidents, and the environment as a focal issue and established the Phnom Penh City Bus Authority in 2014 in order to provide a better public transportation network and service. Like other cities, the city faces severe financial burden to maintain its public transport network and was unable to expand the network as it planned.[5] This prompted JICA to step in and provide its grant aid to procure brand-new buses and technical cooperation through PiBO to strengthen the operation and management capacities within the City Bus Authority.[6]

The PiBO would deliver several data collection system (such as bus location and operation system, safety monitoring system, passenger monitoring system) to provide precise information on bus routes, passenger volume, travel speed, and so on.[7] Representatives from the Ministry of Public Works and Transportation, Phnom Penh City Authority, and the City Bus Authority well acknowledge a modal shift toward public transportation in Phnom Penh as a critical issue, and expect this data collection system will improve accessibility and quality of the city bus system.[8]

Like Vientiane bus project, officials emphasize strong needs for staff capacity strengthening to effectively manage and administer these systems. In addition, they had a strong expectation and belief that data collected could improve management and decision in the public transportation system.[9]

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1. See "Signing of Grant Agreement with Cambodia: Strengthening the Transportation Capacity and Improving Traffic through Public Bus Procurement," press release, JICA, November 30, 2016, https://www.jica.go.jp/english/news/press/2016/161130_01.html; converted amount to U.S. dollars from 1.396 billion yen based on November 30, 2016, exchange rate.
2. "Urban Expansion in Cambodia," *World Bank*, January 26, 2015, http://www.worldbank.org/en/news/feature/2015/01/26/urban-expansion-in-cambodia.
3. "Signing of Grant Agreement with Cambodia."
4. Uong Ratana, "Vehicle Registration Climbs by 15 Per Cent," *Phnom Penh Post*, January 7, 2015, http://www.phnompenhpost.com/business/vehicle-registration-climbs-15-cent.
5. "Signing of Grant Agreement with Cambodia."
6. Ibid.
7. Key stakeholder interview.8. Key stakeholder interview.
9. Key stakeholder interview.

KEY DATA PROJECT OVERCOMING THESE CHALLENGES: REDD+

Background and Key Operating Details

The project on Reducing Emissions from Deforestation and Forest Degradation (REDD+), partially funded by JICA, uses satellite technology to monitor deforestation and create a database of forests

in Laos PDR.[22] Its goal is to address the underlying causes and drivers of deforestation with cooperation in targeted countries. In Laos, JICA has worked with the Forest Information Management Center to establish a robust and transparent Measurement Reporting Verification (MRV) system.[23]

REDD+ primarily uses data from the Hansen Global Forecast Change dataset collected every five years since 2000.[24] These data sets are augmented with field surveys and drone mapping to fill in the gaps where either the satellite resolution is insufficient or data are unavailable. In Laos, most deforestation is caused by a combination of illegal logging, large companies moving into forested areas, and industrial expansion.[25] In northern Laos, deforestation is due to slash-and-burn practices and other agricultural expansion efforts.

Successes in Achieving Its Mission

Laos has policies in place to protect forests and decrease deforestation, but has difficulty enforcing these laws.[26] REDD+ may raise awareness for deforestation issues, which could aid in the enforcement of environmental laws. Continued success of this project will encourage further REDD+ implementation at the national and subnational levels for a variety of Southeast Asian nations, many of which are harmed by deforestation.[27] The REDD+ support project, Sustainable Forest Management and REDD+ Support Project (F-REDD), laid a foundation for this project with a series of trainings for counterparts that can use GIS skills in Laos for this project and other efforts at combatting deforestation.[28]

Challenges in Achieving Its Mission

The databases used for the REDD+ project are expensive, are licensed to a limited number of users, and are only collected once every five years.[29] In some regions, deforestation is a rapid process, and the sporadic data collection does not accurately reflect the situation on the ground. More regular data collection is prohibitively expensive, however. In addition, the data set's limit on the number of users prohibits wider sharing and evaluation of the data. Data sets with a less restrictive policy or less expensive data are less accurate, and would require more field surveys and physical mapping.

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22. "PAREDD: Participatory Land and Forest Management Project for Reducing Deforestation in Lao PDR," *Ministry of Agriculture and Forestry- Lao PDR and JICA*, accessed July 7, 2017, https://www.jica.go.jp/project/english/laos/006/materials/c8h0vm000049tjx8-att/materials_03.pdf.

23. "JICA's Efforts for REDD+ Initiative," *JICA*, December 1, 2015, http://www.reddplus-platform.jp/event/images/20151201_2/1.pdf.

24. Key stakeholder interview.

25. Key stakeholder interview.

26. "Lao PDR Takes Steps to Improve Regulations on Environmental and Social Responsibilities of Investments," UNDP-UNEP Poverty, 2015, http://www.unpei.org/latest-news/lao-pdr-takes-steps-to-improve-regulations-on-environmental-and-social-responsibilities-of-investments.

27. "PAREDD: Participatory Land and Forest Management Project."

28. "F-REDD Newsletter," Quarterly Volume 3, April–June 2016, https://www.jica.go.jp/project/english/laos/018/newsletter/c8h0vm0000a33ddf-att/newsletter_1606.pdf.

29. Key stakeholder interview.

BOX 4.3. Main Takeaways

- Historically, the governing bodies had difficulties collecting or sharing accurate data.
- There is a lack of awareness about the importance of collecting data to formulate a plan for governance and economic growth.
- Lack of critical equipment, such as computers, and weak staff capacity on basic skills such as numeracy and computer aptitude have also hindered data collection and sharing in Myanmar's government.
- In recent years, Myanmar has conducted a number of nationwide surveys as well as reviews of its statistical capacity and strategy with support from the international community.
- Opportunities for changes in the use of data for policymaking include the SATREPS project and possibly a greater investment in cell data.

Given that slash-and-burn land use is a major cause of deforestation and that it is particularly severe in northern Laos, the project must be committed to zoning and land regulation in addition to satellite monitoring.[30]

CASE STUDY: MYANMAR

Background

Myanmar, formerly Burma, is a Southeast Asian country of approximately 57 million people. Myanmar's history as a British colony still has a deep impact on the country; the country endured a series of Anglo-Burmese wars in the nineteenth century, ending in the capture of Mandalay—then a major capital of Northern Burma—in 1885. British occupation gutted the country of its deeply religious roots as well as its monarchy, and the displaced Burmese military leaders and princes led widespread guerilla warfare against the British occupation forces. The British retaliated by strategically razing entire towns to demonstrate its authority.

Myanmar gained independence from Britain in a peaceful transfer of power in 1948, but the subsequent years remained tumultuous. Communists and other political minorities, who had been united against British rule, were dissatisfied with the new government; a communist uprising sparked civil war just eight months into its independence.[31] In 1962 a military coup created a socialist state under military command that lasted until violent protests in 1988.

The first multiparty election was held in 1990, although the military refused to recognize the results and continued to hold economic and political control of Myanmar.[32] In 1997, among

30. "PAREDD: Participatory Land and Forest Management Project."

31. "Burma's History," EBO Myanmar, accessed July 7, 2017, http://www.euro-burma.eu/burma-background/burma-history/.

32. "Myanmar Since 1988," *Encyclopedia Britannica*, https://www.britannica.com/place/Myanmar/Myanmar-since-1988.

continued international calls for the military leadership to honor the results of the 1990 election, the European Union imposed trade sanctions against Myanmar and the United Nations spoke out against the military's history of human rights abuses.

Today, Myanmar is undergoing a "triple transition"—a transition away from dictatorship, a command economy, and conflict toward democracy, a market economy, and lasting peace.[33] Some phases of this transition are more successful than others; the democratic transition has proceeded while conflict and human rights violations are still common, especially in the Rakhine areas toward the Rohingya minority.[34]

Technology and Data Collection

Data collection and interpretation had not been a priority for Myanmar's governments for many years. For example, they had not implemented population census and had estimated the population by using not sufficient and updated data.[35] The United Nations Population Fund (UNFPA) conducted a census in 2014 and found a population of approximately 51.5 million citizens, while the government reports estimated 60 million people.[36] While data collection at the state or municipal level tends to be high quality, the data is often collected on paper and not digitally.[37] Data on conflict areas or otherwise underrepresented groups, including the Rohingya and internally displaced persons (IDPs), are especially sparse.[38]

Despite falling prices and increasing access to cell phone technology, lack of electricity and access to the Internet can create a challenge for digital data collection in Myanmar.[39] While 3G technology could transform the data collection landscape, improving basic numeracy skills among data analysts in government will become crucial.[40] Lack of capacity, incentive, and tools with which to collect and share data remain problems in Myanmar's government. That said, key figures within the national statistical agency indicated that the political shift to Democracy has increased the demand for accurate, timely, and reliable data. There is a clear vision to transform the agency to deliver relevant data to inform and impact public policy.

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33. "World Bank Prepares Interim Strategy Note for Myanmar," World Bank, August 10, 2012, http://www.worldbank.org/en/news/feature/2012/08/10/world-bank-prepares-interim-strategy-note-for-myanmar.

34. Ellen Barry, "'There Are No Homes Left': Rohingya Tell of Rape, Fire and Death in Myanmar," *New York Times*, January 10, 2017, https://www.nytimes.com/2017/01/10/world/asia/rohingya-violence-myanmar.html.

35. Key stakeholder interview.

36. "Myanmar's Census Falls 9 Million Short of Estimate," BBC News, August 29, 2014, sec. Asia, http://www.bbc.com/news/world-asia-28990956; "The 2014 Myanmar Population and Housing Census," Republic of the Union of Myanmar, May 2015, http://myanmar.unfpa.org/sites/default/files/pub-pdf/Census%20Main%20Report%20%28UNION%29%20-%20ENGLISH_0.pdf.

37. Key stakeholder interview.

38. Key stakeholder interview.

39. Key stakeholder interview.

40. Key stakeholder interview.

Key Challenges to Using Evidence in Policymaking

Three of the critical barriers to improved data collection methods in modern Myanmar include the lack of incentive for collecting and sharing high-quality data, a lack of access to computers or other technologies in government institutions, and a general lack of government capacity for data collection. While local government offices may have a good record of economic activity or population, the record is often on paper and not digital, which prevents sharing data between government offices.[41] Mistrust between local and federal ministries further hinders data sharing. For the success of the "triple transition," government transparency and accountability through accessible, accurate, and shareable data is key.

Access to computers creates another issue in government data management and collection. Government offices may have one or two computers available, but most data are collected on paper.[42] These low-tech systems prevent integration and interoperability between ministries.[43] Furthermore, without a concrete policy on what data is shareable, ministries requesting data from a township or city may cause mistrust and confusion.[44]

Lack of human capacity also creates a barrier to the effective use of data in policymaking. Government officials often lack the basic numeracy skills required to analyze data, such as the inability to calculate a mathematical average.[45] Even government officials who have access to computers are often unable to use common computer programs such as Microsoft Office.[46]

However, Myanmar's government is beginning to realize the importance of robust data for government transparency, efficiency, and accountability. Some organizations working with the government have noted an interest in data analysis and improved statistical methods.[47] Establishing and agreeing on a priority order for data needs, including public health, education, agriculture, and census data, is a valuable next step for both the government and international partners.

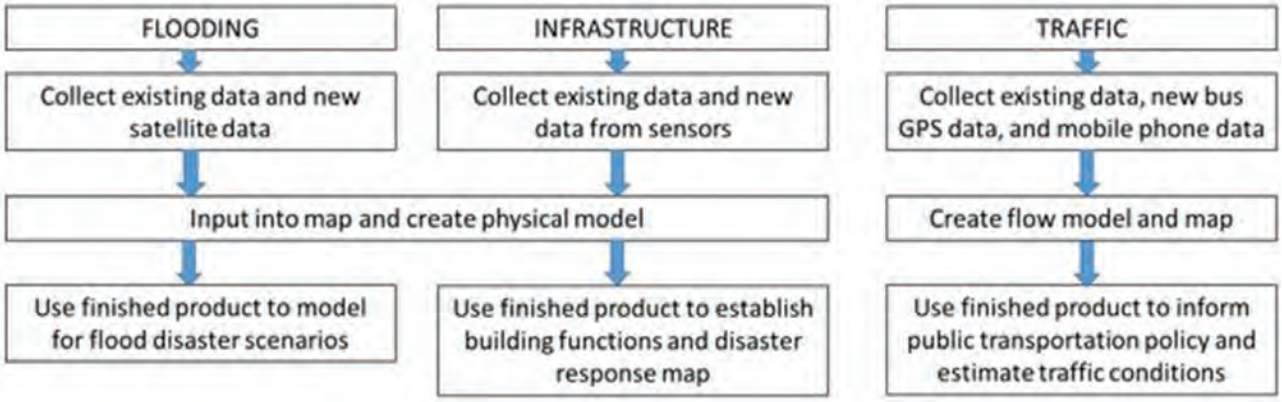
KEY DATA PROJECTS OVERCOMING THESE CHALLENGES: SATREPS

Background and Key Operating Details

The Science and Technology Research Partnership for Sustainable Development (SATREPS) is a Japanese government initiative in collaboration between the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). This initiative, operational in 32 different countries, including Myanmar, focuses on a variety of topics including infectious

41. Key stakeholder interview.
42. Key stakeholder interview.
43. Key stakeholder interview.
44. Key stakeholder interview.
45. Key stakeholder interview.
46. Key stakeholder interview.
47. Key stakeholder interview.

Figure 4.8. SATREPS Operation and Impact



Source: Created by the authors, based on the *Implementation Report 2017: Project for Development of a Comprehensive Disaster Resilience System and Collaboration Platform in Myanmar*, SATREPS, https://www.jst.go.jp/global/kadai/pdf/h2607_h27.pdf.

disease control, natural disaster prevention and mitigation, and natural resource conservation.[48] In this research, we interviewed counterparts from the University of Tokyo and Myanmar.

The overall goal of the SATREPS Project for "Development of a Comprehensive Disaster Resilience System and Collaboration Platform in Myanmar" is to develop the scenario analysis systems administered by the Research Centre for Urban Safety. At present, this project is in the first half stage and contributes to strengthened capacity of academia (Yangon Technological University), and related institutions concerned with disaster prevention (including the Department of Meteorology and Hydrology, Ministry of Construction, Ministry of Agriculture, Livestock, and Irrigation, Yangon City [Yangon City Development Committee], etc.).

Current efforts are collecting and analyzing data on (1) hydrology and flood risk, (2) vulnerability of infrastructure and buildings, and (3) traffic flow observation in target sites. In the next phase, the SATREPS project will try to foster university and government partnerships to provide a comprehensive system for urban disaster prevention and response through data collection, analysis, and use. A part of the data from the SATREPs project is utilized through a single digital platform, known as DIAS, where it can be visualized and analyzed.

The Myanmar project was originated in 2014 and will last for five years. The project has three primary foci, including traffic management, infrastructure cataloguing, and flood modeling and prevention:

1. The traffic management project uses cellular data to estimate passenger flow and collects that information for emergency preparedness and vulnerability.

48. "About SATREPS: Based on the Needs of Developing Countries, the Program Aims to Address Global Issues (Issues That Affect More Than a Single Country or Region, and Cannot Be Resolved without International Collaboration. Examples Include Energy/Environment Issues, Disaster Risk Reduction, Infectious Disease Control, and Food Security) and Lead to Research Outcomes of Practical Benefit to Both Local and Global Society," *SATREPS*, accessed July 7, 2017, https://www.jst.go.jp/global/english/about.html.

2. The infrastructure project's goal is to create a database of land use divided by purpose and repair status. This database of "microtopography" data would also be re-created as a physical model in order to evaluate the effects of a natural disaster on Yangon's infrastructure.
3. The water table and flood plain mapping project collects satellite imagery to catalogue information on water use and integrates them into a global database. A physical model—similar to the infrastructure project—would enable researchers to evaluate the effects of flooding, climate change, and related emergencies.

Successes in Achieving Its Mission

SATREPS will present several opportunities for Myanmar's data collection systems, as well as the role of data in public policy planning. A series of databases for infrastructure, traffic, and water table management could encourage partnership between government ministries as well as outside partners.

A better understanding of infrastructure gaps through such a database could also help government ministries prioritize future investments and inform multilateral development banks (MDBs) and development partners what urgent needs exist.

Challenges in Achieving Its Mission

The completion of the SATREPS programs in Myanmar require innovative solutions such as cell phone use tracking and satellite imaging. It may be difficult for Myanmar's government or private institutions in Myanmar to provide sufficient updates and maintenance for such newly introduced programs, and would instead rely on international institutions to update the surveys. To avoid this, significant training programs for key counterparts such as YTU counterparts should accompany SATREPS' mission in Myanmar.

05

Key Challenges in Executing the Sustainable Development Data Agenda

Developing country governments face any number of challenges including, but not limited to, those presented in Chapter 4. Laos and Myanmar are by no means unique in the challenges they face. The lack of staff or institutional capacity is the main constraint on improving developing country government data. However, common themes do exist and are worth donors and developing countries exploring these opportunities for country-driven improvement as issues of common international interest.

CHALLENGES

Addressing Capacity Constraints at All Levels and Building Awareness around the Value of Data

From survey enumerators to line ministry officials responsible for utilizing data, improved capacity would enhance the use of evidence in policymaking. Staff capacity also drops precipitously when looking beyond national capitals and more urban centers. This poses an additional challenge to gathering accurate data in rural areas, often where these data are most needed for poverty alleviation policy decisions. As a first step, more context-specific research is needed on identifying and measuring the effective capacity needed to enable leapfrog data technologies to succeed.

Millennium Development Goal 2 strived for universal primary education; while the aggregate primary school enrollment rate for developing countries has been consistently over 90 percent, only 35 percent of developing countries were on track to achieve the universal goal by the deadline of 2015.[1] Even for those who achieved the goal, basic numeracy and literacy rates remain low; while primary education is a priority for many national governments and enrollment rates have

1. Hiroko Maeda, "MDG2: Accelerating Progress towards Universal Primary Education," *The Data Blog*, May 20, 2015, https://blogs.worldbank.org/opendata/mdg2-accelerating-progress-towards-universal-primary-education.

increased, the impact on literacy and numeracy is inconsistent at best.[2] While comprehensive data are scarce (which is another challenge entirely), one recent study in Tanzania found that many children were unable to read or do basic arithmetic at the grade 2 level after completing the primary grades.[3] Teacher truancy, overcrowded classrooms, gender discrimination, parental opportunity cost considerations, and a host of other issues limit basic educational improvement in many developing countries, stemming the creation of a pool of numerate and literate citizens (including those who staff data collection and utilization positions).[4] Until educational improvements are shown to improve learning outcomes, literacy and numeracy will continue to pose capacity constraints to data gathering and analysis efforts.

Literacy and numeracy are important to the data revolution because a critical determinate of whether data will be used in policymaking is whether data are understandable and useful. Without meeting basic literacy and numeracy standards, developing countries—especially at the subnational level—will struggle to understand and use data in policymaking.

Adult education and skills training is "a powerful tool for development, including poverty reduction, civic and social engagement."[5] Given the emphasis data collection and analysis places on literacy and numeracy, it also offers great opportunity in this space, specifically in statistics, computer science, and data science. However, these efforts are chronically underfunded and underresearched.

Beyond improving the basic skills listed above, it will also be important to build awareness on the value of data as a tool. Without recognition of the potential benefits data collection and utilization can bring governments and organizations are unlikely to make the necessary investments to build data skills in the workforce. Public private partnerships can be an effective way to create a demonstration effect and build awareness on the value of data, and can also facilitate two-way learning as knowledge generated in developing countries is absorbed into the developed context.

Though much international attention is given to the potential of big data, *developing country governments should prioritize improving capacity of its current and potential staff members to execute small data tasks over attempting to explore big data*. When possible they should do both; however, in the reality of finite resources, foundational data systems capacities should be prioritized. The focus of the UN Independent Expert Advisory Group on a Data Revolution for Sustainable Development on mobilizing new resources for capacity development is important but insufficient. *Developing country governments should make basic literacy, numeracy, and overall staff capacity a priority while building awareness around the value of data.*

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2. Jacques van der Gaag and Vidya Putcha, "From Enrollment to Learning," Brookings Institution, 2016, https://www.brookings.edu/wp-content/uploads/2016/06/01-enrollment-learning-van-der-gaag.pdf.

3. Uwezo Kenya, "Are Our Children Learning," 2011, http://www.pokot.org/wp-content/uploads/2012/05/Uwezo-2011.pdf.

4. Joseph PG Chimombo, "Issues in Basic Education in Developing Countries: An Exploration of Policy Options for Improved Delivery," *Journal of International Cooperation in Education* 8, no. 1 (2005): 129–152.

5. James Jinna Yilben and P. N. Maikano, "The Role of Adult Education in National Development," *International Letters of Social and Humanistic Sciences* 32 (June 2014), http://www.scipress.com/ILSHS.32.35.

Creating the Appropriate Enabling Environment for Leapfrog Data Technologies to Have Transformational Impact

Chapter 3 presents a three-stage framework for successful creation of an enabling environment that would allow for leapfrog data technologies to take hold: first comes the foundation, then the introduction of the technology or innovation, and lastly continual refinement. However, finding the appropriate, context-specific policy and regulatory foundation for this to occur is a challenge. The right mix of laws, support to public private partnerships, levels of public consciousness, and staff capacity (as outlined above) necessary to realize the data revolution will differ greatly depending on the country, province, even locality.

At the heart of the challenge are weak governmental institutions. The institutions required to implement complex and contentious tasks—which describes most governance situations even in nondeveloping country contexts—are, in many cases, steadily declining.[6] Additionally, the types and forms of data required by these institutions are diverse and often require technical skills beyond the scope of most policymakers and bureaucrats. These types of data and, importantly, the resources required to gather and analyze them, are not well understood.

As discussed in Chapter 3, leapfrog data technologies and innovations have transformational potential. Without the appropriate enabling environment, their impact will be limited. *Developing country governments should focus on understanding and delivering the institutional framework that will enable leapfrog data technologies to succeed.* They must also be willing to spend the time and resources to developing the foundation necessary for frogs to leap. This includes building awareness around the value of data as mentioned above.

Confronting Data Sharing, Ownership, and Privacy Concerns

Once data are collected, sharing, ownership, and privacy concerns abound. For many reasons from politics and the potential for embarrassment to questions on data accuracy, policymakers are often hesitant to make data public or even share them across ministries. There needs to be a global commitment to data partnerships that enable the spread of data and technology and facilitate cross-organizational learning and innovation.

Many countries have decided to accept the idea that government data should be "open." Doing so can (1) more effectively target aid money and improve development programs, (2) track development progress and prevent corruption, and (3) contribute to innovation, job creation, and economic growth.[7] Doing so can, more broadly, help countries achieve the SDGs. Despite these potential benefits, in many countries—including but not limited to Laos as discussed in Chapter 4—data sharing is one of the challenges. *Developing country governments should make a commitment to open data.* The failure to do so is one reason why there is already an

6. Matt Andrews, Lant Pritchett, and Michael Woolcock, "Building State Capability," Oxford University Press, March 26, 2017, https://global.oup.com/academic/product/building-state-capability-9780198747482?cc=us&lang=en&.

7. Oleg Petrov, "Open Data for Sustainable Development," World Bank, March 17, 2016, http://www.worldbank.org/en/topic/ict/brief/open-data-for-sustainable-development.

increase in the number of "data graveyards,"[8] which, at the very least, is a waste of finite resources.

Questions of data ownership and privacy are challenging to answer while being critically important. Consumers in the United States are preoccupied with companies "data mining" their private data to sell them more targeted products. The burden of protection is even greater when the issue turns to HIV status or annual income. These household level health, economic, and demographic data are crucial when determining future government programs; they also include significant portions of personal and sensitive information. Who owns these data (e.g., governments, individual, or data collectors), how and when it should be used, who has power to modify, package, derive benefit from, or assign access to it—these are all important questions requiring international norms and protocols. *Developing country governments should advocate for seats at the table during these negotiations.* The privacy of their citizens depends on it.

Navigating Complex Political Environments

Politics and political considerations differ not just from country to country but often from town to town. The political will necessary to put resources toward data collection, to analyze and to use in policymaking, and to share publicly is as necessary as it is challenging. There are examples from around the world where data are manipulated for political purposes: Inflated GDP statistics. Foreign direct investment figures based on planned rather than actual investments. A refusal to collect or disseminate data for fear of embarrassment. These and myriad other reasons present challenges to harnessing the data revolution for sustainable development. Data have powerful political persuasion potential; they are also critical for development. *Developing country governments should, from the highest to the lowest levels, prioritize quality in data collection and reporting, putting in place the appropriate structures to incentivize quality.* Strong, proactive leadership is a critical ingredient to policy success. However, mobilizing stakeholders in and outside governments around the data revolution can be challenging. One way to do this is to use the convening power of national development plans to mobilize disparate parts of governments around a unified data plan. Without successfully navigating politics, even the most transformational of leapfrog data technologies are at risk of failure. Another way of navigating political realities is to tie data dissemination to internationally recognized standards like the International Monetary Fund's Standards for Data Dissemination.[9]

8. "Avoiding Data Graveyards: Insights from Data Producers & Users in Three Countries," AidData, 2017, http://aiddata.org/avoiding-data-graveyards.

9. "IMF Standards for Data Dissemination," International Monetary Fund, accessed June 9, 2017, https://www.imf.org/en/About/Factsheets/Sheets/2016/07/27/15/45/Standards-for-Data-Dissemination.

06

Recommendations for the International Community to Play a Constructive Role in the Data Revolution

The international community—including bilateral donors and multilateral organizations, NGOs, research organizations and universities—has the opportunity to address the challenges put forth in Chapter 5 alongside developing country governments. These governments must be receptive to change and to learning from best practices funneled through international groups; these groups must, in turn, provide actionable solutions based on lessons learned from other developing country contexts. The international community can further support the data revolution for sustainable development in the following ways.

RECOMMENDATIONS

Do Not Fixate on Big Data Alone—Focus on the Foundation Necessary to Facilitate Leapfrogs around All Types of Data: Small, Big, and Everywhere in Between

The UN Global Pulse and the UN Global Working Group on Big Data for Official Statistics are only two of the organizations within the official UN apparatus working toward the data revolution (a more comprehensive list can be found in Appendix A). Both have missions to harness big data while many developing country governments are struggling even to collect small data. This divergence in focus has important ramifications. Though Global Pulse does not automatically draw resources from the United Nations, it is consuming finite development resources for big data purposes. Though big data could eventually have a great impact on the developing world, the United Nations and other groups risk "putting the cart before the horse" if big data is prioritized ahead of methodological and capacity improvements.

While leapfrog opportunities should continue to be explored, the primary focus should be on methodological and capacity improvements that could have broader, more sustainable—albeit slower to realize—outcomes. Investments in small data should be focused on the foundational elements necessary to enable the full integration of leapfrog technologies on the road to the data revolution. As part of this process, it may be sensible to start with projects that build awareness and demonstrate the value of data to build interest in broader initiatives and partnerships. In building the foundation for leapfrog data technologies to thrive, donor coordination is also critical; while many have useful goals, they undermine their own efforts by not coordinating and by wanting to fund "sexy" projects rather than less sexy but important core functions of statistical offices.

Stronger Focus on Capacity Building as Part of an Expansion of Broader Educational Development Priorities

As discussed in Chapters 3 and 5, low staff capacity remains a fundamental issue in developing countries writ large. The effects of this are particularly acute in the world of statistics where numeracy and literacy are critical to successful collection and analysis of data. Globally, an estimated $54 billion is needed annually to provide universal quality basic education, i.e., literacy and numeracy to children, though current funding levels hover around $28 billion (mostly government spending but also around $3 billion from donor aid).[1] The international community should first study and showcase the value of capacity development, particularly as it relates to the ability of governments to use evidence in decisionmaking. Resource poor countries are unlikely to invest in this without seeing the tangible value to them doing so. Then the international community must work to close the funding gap and, better still, increase overall funding to include adult education and skill building, particularly in computer and data sciences.

This can be achieved, in part, by acknowledging that core capacity development is critical to almost any development initiative. As was the case with the JICA-funded bus projects in Laos and Cambodia, donor projects can have a catalytic effect on staff capacity while not being officially focused on skill building. Even if projects are not specifically data related, increased importance can be given to this across all programming. Acknowledging that learning is essential in all initiatives and can be achieved at any age is an important step in addressing the capacity development challenges faced by the data revolution for sustainable development. There is a necessary link between realizing the development data revolution and building the necessary human capacity; programs that specifically target this gap should receive funding priority.

Highlight, Share, and Support Enlightened Government-Driven Approaches to Data

A critical role of the international community should be to highlight enlightened or innovative approaches to data and to share best practices. For example, the government of Laos overcame a key political challenge after its last census: while the population was expected to be above seven million, the results of the census showed less than that. The government decided to go with the more accurate, though originally unanticipated and undesired, figure. This and similar decisions

1. "Seven Facts about Global Education Financing," Brookings Institution, February 2014, https://www.brookings.edu/blog/education-plus-development/2014/02/20/seven-facts-about-global-education-financing/.

from the developing—and nondeveloping—world should be studied, lauded in international forums, and ultimately shared broadly. While multilateral institutions (MDBs, the United Nations, etc.) are best positioned to do this, bilateral donors should actively share information—not only final reports but, when possible, raw data sets—between their countries of operation and amongst one another. In many developing countries, interministerial partnerships around strengthening government data capacity can also facilitate the diffusion of data awareness and capabilities.

Increase Funding for the Data Revolution and Improve Donor Coordination Efforts

As the IEAG rightly pointed out, new resources will be needed for statistical strengthening, including but not limited to capacity building. Of the around $650 million per year needed to collect data alone, only $250 million per year is currently funded.[2] The challenge of creating the necessary enabling environment discussed in Chapter 5 should be supported by the United Nations and multilateral institutions, namely, the International Monetary Fund, the World Bank, and other multilateral development banks. Using the Global Partnership for Sustainable Development Data as the primary aggregator of needs and priorities, these institutions should be the main—although not only—funding engines of the data revolution. In fact, the Global Partnership already plays this role in its active countries; based on an analysis of where gaps exist, it should seek funds for the significant scaling up that would be needed to play this positive role wherever needed. A result of the coordination should be comprehensive, country-specific and country-driven support, potentially through data compact-type arrangements whereby donors and stakeholders commit to national data plans. Many bilateral donors are also operating in this space, and their experiences can be sources of learning; JICA has active statistical capacity building projects in Indonesia, Cambodia, Egypt, and Bhutan, for example. Bilateral efforts should be coordinated closely with multilateral efforts—using the convening and aggregating powers of the Global Partnership if appropriate—to avoid duplication.

Coordinate UN Data Revolution–Related Activities Closely with an Expanded Global Partnership for Sustainable Development Data

The UN alone has at least five separate, international entities tasked with achieving progress toward the data revolution. Many more UN and non-UN entities have similar "data for development" related goals (see Appendix A). At least two of them—the Global Partnership for Sustainable Development Data[3] and the SDG Data Labs[4]—were created as a result of the 2014 report by the Independent Expert Advisory Group on a Data Revolution for Sustainable Development (IEAG) commissioned by Ban Ki-moon.[5] The Global Partnership, led by the same person who executed

2. "The State of Development Data Funding," Open Data Watch, 2016, http://opendatawatch.com/the-state-of-development-data-2016/.

3. "Who We Are," Global Partnership for Sustainable Development Data, accessed July 7, 2017, http://www.data4sdgs.org/who-we-are/.

4. "SDG Data Labs," accessed July 7, 2017, http://www.sdgdatalabs.org/.

5. "A World That Counts: Mobilising the Data Revolution for Sustainable Development," Independent Expert Advisory Group on a Data Revolution for Sustainable Development, November 2014, http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf.

the IEAG report that should be considered the foundational data revolution for sustainable development document, should be the main focal point for SDG-related and data revolution–related efforts. More analysis should be done on which official UN functions (many of which are listed in Appendix A) serve duplicative roles with the Global Partnership; these functions should be ceased or transferred to the independent Global Partnership. Additionally, the SDG Data Labs should strongly consider merging into an expanded Global Partnership that can serve as the primary, independent champion of the data revolution. The Global Partnership can then offer "consulting"-type services to UN and non-UN agencies when they are designing projects, ensuring they are building capacity, focused on collecting appropriate and useful data, planning to share collected data appropriately, and handling data sharing and ownership, and privacy concerns per international standards. Ultimately, an expanded Global Partnership should build independent support and consensus and test out innovative approaches which can, over time, be brought into the slower, more bureaucratic—and necessarily more constrained—UN system. Even today the Global Partnership has a mandate to be a catalytic, convening, and collaborative entity; this should be seen as an opportunity for UN stakeholders, governments, civil society members, technology and business entrepreneurs, and public private partnerships. With reform and an expanded mandate, the Global Partnership can also transform how the data ecosystem operates to support the achievement of the SDGs by 2030.

Secure Consensus on Data Sharing, Ownership, and Privacy-Related International Standards through the Global Partnership

The IEAG called for the development of a "global consensus on principles and standards."[6] This report strongly endorses that recommendation and further recommends that the Global Partnership for Sustainable Development Data play a primary convening roll in facilitating this global consensus. Though a UN commission could play a similar role, the independence and multistakeholder nature of the Global Partnership better positions it to do so. Achieving consensus will be challenging and will require significant inertia from the bottom up. The Global Partnership is also better positioned to leverage that inertia while learning from relevant existing UN and non-UN agreements. A lack of internationally recognized and agreed-on standards relating to data sharing and ownership, and privacy concerns are of particular concern. Though incremental and fragmented progress is possible without it, only after securing this broad consensus will developing countries, the international community, and the Global Partnership be able to advance toward a unified 2030 data agenda. Without this consensus, the data revolution will proceed in a fragmented way, complicating not just data aggregation concerns but critical data protection concerns. Data should be seen as a force for good that everyone wants to utilize and share; only after proper protections and standards are in place can these aspirations become reality.

6. Ibid.

Appendix A. UN Organizations and Entities Dealing with Data

INITIATIVES DIRECTLY RELEVANT TO THE DATA REVOLUTION

- Global Partnership for Sustainable Development Data
    - DATA4SDGS Highway
- SDG Data Labs
    - Open Data Platform focusing on data visualization and analysis tools
- Global Working Group on Big Data for Official Statistics
    - Committee on Global Platform for Data, Services, and Applications
    - Training, skills, and capacity building
- United Nations Statistical Commission
    - United Nations Statistics Division
    - UNData
- UN World Data Forum
    - First held in South Africa in January 2017, it is a platform for "intensifying co-operation with various professional groups, such as information technology, geo-spatial information managers, data scientists, and users, as well as civil society stakeholders."
- United Nations Global Pulse
    - Harnessing big data for development and humanitarian action
- Millennium Indicators Database
    - Forty-eight indicators to measure progress toward the achievement of the Millennium Declaration development goals

- PARIS21
    - Partnership in Statistics for Development in the 21st Century

OTHER UN-LED DATA INITIATIVES

- UN Good Practices Database
    - View this valuable source of information in good practices in official statistics.
- UN Social Indicators
    - Tables with social indicators covering fields such as education, housing, health, and water
- Commodity Trade Statistics Database (COMTRADE)
    - UN Comtrade is a repository of official trade statistics and relevant analytical tables. It contains annual trade statistics starting from 1962 and monthly trade statistics since 2010.
    - Data
    - Visualize Data
- UN Demographic Yearbook System
    - Statistics on population size and composition, births, deaths, marriage, and divorce
- Distat, the United Nations Disability Statistics Database
    - Basic statistics on human functioning and disability
- Joint Oil Data Initiative (JODI)
    - View the monthly oil data for the countries reporting to UNSD.
- Monthly Bulletin of Statistics Online (MBS Online)
    - This Internet database presents current monthly economic statistics for most of the countries and areas of the world.
- National Accounts Main Aggregates Database
    - Contains a complete and consistent set of time series of main national accounts aggregates from 1970 onward.
- UN Population and Vital Statistics on Internet
    - Quarterly report on the latest census and mid-year population; latest vital statistics of births, deaths, and infant deaths
- UN Service Trade Statistics
    - UN ServiceTrade, the United Nations database with Statistics on International Trade in Services, contains annual detailed trade in services data.

- UN Statistics and Indicators on Women and Men
    - Statistics and indicators on six specific fields of concern: population, families, health, education, work, and politics and human rights
- Population and Housing Censuses: Census Dates
- Population of Capital Cities and Cities of 100,000 and More Inhabitants

Most organizations within the United Nations have their own databases updated sometime in the last five years.

- United Nations Statistics Division (UNSD)
    - Commodity Trade Statistics Database
    - Energy Statistics Database
    - Environment Statistics Database
    - Gender Info
    - Global Indicator Database
    - Indicators on Women and Men
    - Industrial Commodity Statistics
    - Millennium Development Goals Database
    - National Accounts Official Country Data
    - Sustainable Development Goals Indicators
    - UNSD Demographic Statistics
    - National Accounts Estimates of Main Aggregates
- United Nations Framework Convention on Climate Change (UNFCCC)
    - Greenhouse Gas Inventory Data
- United Nations Development Programme (UNDP)
    - Human Development Indices: A Statistical Update 2015
    - World Fertility Data
    - World Marriage Data
    - World Population Prospects: The 2012 Revision
- United Nations Children's Fund (UNICEF)
    - The State of the World's Children
    - UIS Data Centre UNESCO Institute for Statistics
- United Nations Programme on HIV/AIDS (UNAIDS)
    - UNAIDS Data Joint

- United Nations High Commissioner for Refugees (UNHCR)
    - UNHCR Statistical Database
- United Nations Office on Drugs and Crime (UNODC)
    - UNODC Homicide Statistics 2012
- United Nations Population Division (UNPD)
    - World Contraceptive Use
- World Meteorological Organization (WMO)
    - World Meteorological Organization Standard Normals
- World Tourism Organization (UNWTO)
    - World Tourism Data
- Food and Agriculture Organization (FAO)
    - FAO Data
- World Health Organization (WHO) Information
    - WHO Data

TOP OUTSIDE ORGANIZATIONS THAT UN USES FOR DATA COLLECTION

- Organization for Economic Cooperation and Development (OECD)
    - OECD Data
- The World Bank (WB) Information
    - World Development Indicators
- World Bank Development Data Group
- International Monetary Fund (IMF) Information
    - International Financial Statistics
- International Labour Organization (ILO)
    - Key Indicators of the Labour Market, 7th Edition
    - LABORSTA
- International Telecommunications Union (ITU) Information
    - World Telecommunication/ICT Indicators Database
    - World Telecommunication/ICT Indicators Table

- Data Pop Alliance
- Data Test Initiative

RELATED U.S. GOVERNMENT ENTITIES

- Millennium Challenge Corporation and PEPFAR
    - Data Collaboratives for Local Impact
    - dLab

Appendix B. Additional Data Use Case Examples

ICT PARTNERSHIP[1]

Rwanda's current National Development Policy titled "Vision 2020" listed ICT promotion as a strategic priority area. This is influenced by efforts by the Rwandan government to implement ICT infrastructure development and human resource development under National ICT Strategy and Plan (NICI). After Kobe City signed a joint partnership with Kigali for ICT cooperation in business, academic, and administrative centers in May 2016, JICA has responded by dispatching experts on ICT policy to support their use in a variety of industries. One of the expected impacts of this project is that greater business matching and business ties between companies in Kobe and Rwanda that are contributing to growth in Rwandan industries.

SMART AGRICULTURE FARM[2]

Fujitsu is deploying an agricultural ICT service known as "Akisai." Fujitsu has established laboratory facilities and vegetable factories in Japan and operates a showroom in Hanoi Province in Vietnam as an overseas expansion.

In Ha Nam Province, Vietnam, in collaboration with Japanese Agricultural Cooperation (AION Agri-Create Co. Ltd.), Fujitsu conducted a demonstration project of safe and high-quality agricultural production through Japanese farming methods. In the demonstration project, Fujitsu recorded farming work on smartphones, accumulated growing conditions and soil data. These data were then given to farmers in easily consumable formats, including graphs and data aggregation. This provided a demonstration effect for the potential value data could contribute to high-quality agricultural production profit margins. It is expected that this data driven agricultural management will increase crop safety and improve productivity in Vietnam.

1. Rwanda's Development and Kobe City's Capacity Development, JICA.
2. Takeshi Wakabayashi, "Fujitsu Smart Agriculture," Fujitsu Limited, November 9, 2016.

Figure B.1. Rwanda's First Fabrication Laboratory (Fab Lab)

As part of the business startup support activity of ICT Private-Sector Development & Policy Development Support in Rwanda, JICA supports setting up the country's first fabrication laboratory (Fab Lab)
Source: Photo by JICA, used with permission of license holder.

SATELLITE DATA USE

Researchers interviewed RESTEC (Remote Sensing Technology Center of Japan) and Kokusai-Kogyo (Geospatial Information Consultant) to better understand the utilization of satellite data.

RESTEC provided examples of utilizing satellite data to prevent the spread of polio; research on the relationship between malaria onset and weather conditions, disaster prevention, and changes in vegetation and topography were introduced.

From Kokusai-Kogyo, we saw examples of satellite data being used to assess tsunami damage following the Great East Japan Earthquake, monitor infrastructure in Asia and Africa (REDD+), and monitor dams and crop growth through infrared rays.

Satellite data have a wide array of potential uses, including the possibility of continuous observed data, observing minute topographical height difference through microwave interference processing, and the generation of new data by infrared rays.

Figure B.2. Fujitsu Demonstration Project in Ha Nam Province, Vietnam: Entering Data on the Smartphone App

Source: Photo by Fujitsu Limited, used with permission of license holder.

Figure B.3. Satellite Image of Mount Everest in Nepal—Photo by Axelspace Corporation

Source: Photo by Axelspace Corporation, used under an Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0), https://www.axelspace.com/en/hodoyoshi-1-images/everest_/.

Figure B.4. Using the Mobile CTG

Source: Photo by Kagawa University, used with permission of license holder.

Axelspace, a micro satellite development company, is pursuing an initiative known as "AxelGlobe" through which they hope to establish the ability to observe the entire earth at all times. This would be achieved through a network of small and inexpensive satellites. Full earth observation is expected to be included as one of the six themes of the World Data Forum "understanding the world through data."

E-MATERNITY[3]

Kagawa University's core group in Thailand is conducting a project, implemented through JICA's grassroots cooperation, known as Telemedicine using the Electronic Maternal and Child Health book and Mobile CTG (Cardio Toco Gram)[4]. Through this project, the perinatal server at Chiang Mai University is connected to remote hospitals (three places) and one clinic (one site) 100–150 kilometers away from Chiang Mai University Hospital via a mobile CTG network. This network allows pregnant women in remote areas to receive the benefit of medical technology located at

3. Kazuhiro Hara, "The Standardization of the Electronic Maternity Passbook and Development of the Micro Miniature Mobile CTG," JICA Scope Meeting Ichigaya, November 9, 2016.

4. Project Name: "A Collaboration Project for the Development of ICT Telemedicine for Perinatal Care and Diabetes in Thailand."

Figure B.5. Overview of the Cloud-Based Telemedicine Platform

Source: Photo by Melody International, used with permission of license holder.

Chiang Mai University. Telemedicine using data is expected to contribute to the health of individuals in rural or remote areas without access to traditional medical facilities.

In addition, the Electronic Maternal and Child Health book are also used in other countries. As one example, Electronic maternal and child handbooks are provided to Palestinian refugees through cooperation with JICA and the UN Palestine Refugee Relief Organization (UNRWA). It is expected that this will contribute to maternal and child health by being able to receive screenings at the evacuation destination. This Data approach can contribute not only to SDGs Goal 3 (good health and well-being) but also to SDGs Goal 16 (peace, justice, and strong institutions).

BIOMETRIC ID[5]

With the brand statement of "orchestrating a brighter world," NEC Corporation, an ICT global enterprise with 118 years of history, determines itself to be a social value innovator by integrating

5. Shinya Kukita, "Towards SDGs-ICT Vendor's View," Global Business Unit at NEC Corporation, November 9, 2016.

Figure B.6. NEC Urban Surveillance System in Tigre, Argentina

Source: Photo by NEC Corporation, used with permission of license holder.

its leading-edge technologies, know-how, and ideas while working together with their customers and partners around the world to realize abundant lives and a brighter society and future for all.

In this context, NEC is participating in the United Nations Global Compact and is aligned to the Sustainable Development Goals.

Regarding Social ID, NEC has conducted research and development in Biometrics for more than 40 years and has been ranked number one many times by the National Institute of Standards and Technology.

Among the worldwide success cases, NEC explained about the National IDs in India and South Africa, voter ID in Bolivia, as well as the case of creating a safe and secure city in Tigre, Argentina.

In addition, in the case of transportation IC cards in Bangladesh listed in Chapter 3, NEC also utilizes ICT to try to resolve traffic congestion problems in cities common to developing countries. It is expected that these activities will contribute to the achievement of various SDGs.

Appendix C. Stakeholder Meetings That Informed This Report

IN LAO PEOPLE'S DEMOCRATIC REPUBLIC

Department of Forestry, Forest Inventory and Planning Division

Embassy of Australia, Development Cooperation

Embassy of France

Foundation Jean Jares

JICA Laos

Korea International Cooperation Agency

Ministry of Foreign Affairs, Republic of Korea, Development Policy Division

Ministry of Public Works and Transport, Department of Transport

Ministry of Public Works and Transport, Department of Transport, Land Transport Division

Sustainable Forest Management and REDD+ Support Project

USAID Laos Country Office

U.S. Department of State

Vientiane Bus Operation Optimization Verification Survey, Eagle Bus

Vientiane Capital State Bus Enterprise

Vientiane Department of Public Works and Transport

The World Bank

IN MYANMAR

Asian Development Bank (ADB)

JICA Myanmar

Ministry of Construction, Department of Bridges

Ministry of Finance and Planning, Central Statistical Organization

Ministry of Transport and Communication, Directorate of Water Resources and Improvement of River Systems (DWIR)

Ministry of Transportation

Myanmar Information Management Unit (MIMU)

UK Department for International Development (DFID)

U.S. Department of State

The World Bank

Yangon Central Development Committee (YCDC)

Yangon Technical University (YTU)

About the Project Directors and Authors

Naohiro Kitano is director of JICA Research Institute (JICA-RI) at the Japan International Cooperation Agency (JICA). In 1983 he graduated from the Civil Engineering Department of Waseda University and joined former Overseas Economic Cooperation Fund, Japan (OECF). Prior to the current assignment, he served as associate professor in the Graduate School of Economics at Kyoto University from 2003 to 2005; as director general of the Development Assistance Department II at the Japan Bank for International Cooperation (JBIC) in 2008; as director general of the East, Central Asia, and Caucasus Department at JICA from 2008 to 2012; and as deputy director of the JICA Research Institute from 2012 to 2016. He studied in the Department of Civil and Environmental Engineering at Tsinghua University in Beijing from 1981 to 1982 and obtained a PhD in city and regional planning from Cornell University in 1997.

Dr. Kitano's publications include "Estimating China's Foreign Aid II: 2014 Update," JICA-RI Working Paper No. 131, JICA Research Institute (June 2016), and "China's Foreign Aid at a Transitional Stage," *Asian Economic Policy Review* (July 2014).

Daniel F. Runde is director of the Project on Prosperity and Development and holds the William A. Schreyer Chair in Global Analysis at CSIS. His work centers on leveraging American soft power instruments and the central roles of the private sector and good governance in creating a more free and prosperous world. Previously, he led the Foundations Unit for the Department of Partnerships & Advisory Service Operations at the International Finance Corporation. His work facilitated and supported more than $20 million in new funding through partnerships with the Bill and Melinda Gates Foundation, Rockefeller Foundation, Kauffman Foundation, and Visa International, among other global private and corporate foundations.

Earlier, Mr. Runde was director of the Office of Global Development Alliances at the U.S. Agency for International Development (USAID). He led the initiative by providing training, networks, staff, funds, and advice to establish and strengthen alliances, while personally consulting to 15 USAID missions in Latin America, the Middle East, and Africa. His efforts leveraged $4.8 billion through 100 direct alliances and 300 others through training and technical assistance. Mr. Runde began his

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