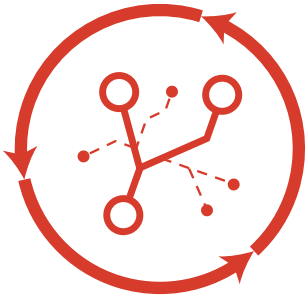


CHAPTER 6

Global cooperation

Data, spam, disease, poverty, commerce, rivers, and polluted air—all cross borders and touch many people. And all can be better managed if people and nations cooperate. The internet is both a subject of cooperation and a new tool to facilitate cooperation in other realms. This chapter explores its potential for boosting three forms of cooperation.

First is *governing the internet*. The internet requires technical coordination and harmonized standards to ensure its smooth operation worldwide. Wherever you are, when you click or tap on http://www.worldbank.org/wdr2016, a message goes out from your device, initiating processes to discover which of the millions of servers on earth corresponds to that address. Information is handed off from network to network and perhaps from satellite to cable to Wi-Fi, ending up on your screen. That nanomiracle depends on the consensual and universal use of protocols for data transmission and on a legal system that determines who has the right to use the "worldbank.org" address. Less consensus exists about how to deal with cross-border issues such as suppressing viruses and spam, or defining and enforcing rights to privacy, while ensuring cybersecurity and combating cybercrime (see chapter 4). As technology and its uses evolve rapidly together, who decides how the internet is structured and run?

Second is *facilitating cross-border exchanges of goods and services*. During the last two decades or more, countries have worked out trade agreements to collect duties and taxes and to enforce intellectual property rights (IPRs): patents, copyrights, and trademarks. Many of these agreements are poorly adapted for the world of the internet because intellectual property can be duplicated and disseminated with little or no cost, and purely digital goods and services can now cross borders without customs inspections. The increasingly frictionless ease of transacting business can be stymied by 19th-century procedures for shipping physical objects. Can trade and IPR rules and procedures be modernized?

Third is *providing global public goods*—including poverty reduction and environmental sustainability. These are complex and difficult challenges requiring both cooperation and massive amounts of information. Can the advent of the internet make these quests more inclusive, more informed, and more efficient?

Internet governance

We reject: kings, presidents, and voting. We believe in: rough consensus and running code.

—David Clark, computer scientist and internet pioneer[1]

From its beginnings, the internet has always been different from the networks that preceded it—telephone, radio, television, and cable. It was founded as a research network, explicitly noncommercial for the first few decades of its existence, and designed as a radically decentralized network. As a result, it has been governed more like a federation of networks, in some respects like a Republic of Users.[2] But the pragmatic libertarian ideology of the internet's founders is under assault by the commercial and political interests of its other stakeholders, mainly large corporations and nation-states. The growing commercialization of user data by private businesses and mass surveillance by states, including many sovereigns accustomed to greater state control over their citizens, have gradually eroded the trust the internet once enjoyed. This has given rise to widely disparate views on how to govern the internet.

The internet's growing popularity has increased the need to manage its worldwide operation. Whereas less than 2 percent of phone calls cross borders, between 60 and 75 percent of internet traffic is international (depending on the country). Despite

its virtual qualities, it has an elaborate physical infrastructure that spans the globe. As a global resource, it requires some degree of international coordination to function. Information flowing through the internet has transboundary repercussions, raising other issues for international debate and discussion. To address these issues, the United Nations–authorized Working Group on Internet Governance defined internet governance as "the development and application by governments, the private sector, and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programs that shape the evolution and use of the Internet."[3]

How is the internet governed?

The main attributes of the global internet are that it is distributed, decentralized, flexible, multilayered, and end-to-end.[4] Not a monolith, it is instead a mosaic of separate but interrelated infrastructure, applications, actors, and decisions. Consequently, its governance is likewise not unitary but consists of an ecology of decisions and decision makers. Internet governance features are different from those in telecommunications, characterized by a multilateral system.

The governance framework for the internet is considerably more diverse than that of the telecom sector. The policy, legal, and regulatory framework for information and communication technologies (ICTs) has shifted since the start of the millennium. Then it was primarily about the technical and economic regulation of more liberalized and competitive telecommunications infrastructure and services environment—along an arc with the state at the center of the policy and regulatory piece and state-licensed operators orbiting around it. Now it is a much more complex, multifarious, and loose amalgam of policies, laws, and actors having their origins in constitutional rights, criminal justice, and technical and economic regulation. This new framework also involves nonstate actors, national, regional, and even multilateral agents—each with an interest in the wide-ranging and diverse aspects of what has come to be known as the internet governance framework.

The prevailing model of internet governance continues to evolve to include its key stakeholders. The multistakeholder model (MSM) reflects the notion that better policies and outcomes can be achieved if those affected are part of a policy consultation process;[5] it also refers to the range of actors running, administering, and governing the internet.[6] The term came into popular use as a result of the UN's World Summit on the Information Society, held in two phases in 2003 (Geneva) and 2005 (Tunis). The summit confirmed that "management of the internet encompasses both technical and public policy issues and should involve all stakeholders."[7] As described in its agenda, the groups of stakeholders with an interest in internet governance include governments, private firms, civil society, intergovernmental and international organizations, academia, and the technical community (box 6.1).

The MSM label reflects the diverse actors that form the loose de facto framework for internet governance. For example, one of these stakeholders is the Internet Engineering Task Force, a loose affiliation of engineers that is in charge of the protocols that run the internet. Another is ICANN, the Internet Corporation for Assigned Names and Numbers, a California not-for-profit corporation that performs certain technical functions on the internet—such as running root servers (the computers that control traffic on the internet) and administering the system of domain names (.com, .org, .gov). But not all stakeholders feel equally represented within the current governance framework.

The internet unites people; its governance divides nations

Politicians and regulators are increasingly concerned about their inputs into the future governance of the internet.[8] Their concerns may be justified (figure 6.1):

- The rapid and unprecedented growth of the internet has meant that it has evolved from an American technology to a critical global infrastructure in a very short period. This has given rise to an unstated power struggle between its traditional stakeholders and many new ones, especially some developing country governments, which feel left out of the discussion.
- The bulk of internet nonusers are in developing countries—4.2 billion people, more than half the world, have no internet access, and 5.1 billion are not on social media. Their interests, some argue, are best promoted by their national governments.
- Mass collection of user data by private businesses and unwarranted surveillance by governments have eroded trust and fed growing skepticism about the current governance arrangement.
- Increasing use of social media and unhindered access to all content, which is generally thought to be a positive development, can clash with local cultural norms and social practices, prompting some governments to advocate a more activist approach to govern the internet.

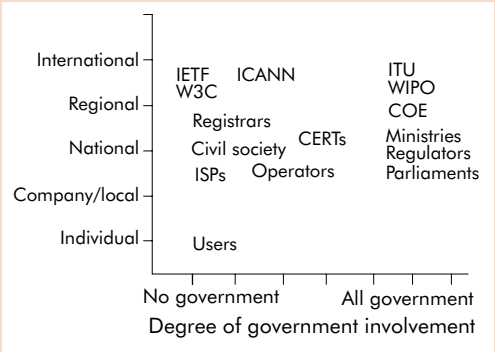
Box 6.1 Categories of stakeholders in internet governance

Individuals, organizations, and institutions with an interest or stake in particular internet governance issues include:

- States, which have policy authority for sovereign nations and are responsible for internet-related public policy issues at the global level
- Private businesses, with expertise in technical and economic fields
- Civil society, especially at the community level
- Intergovernmental organizations, particularly in facilitating the coordination of internet-related policy issues
- International organizations, with important roles in developing internet-related technical standards and relevant policies
- Technical communities, such as the members of technical standard-setting bodies and other experts in computer science and engineering
- Academics, with a focus on and involvement in internet governance.

Figure B6.1.1 maps these stakeholders according to their degree of localization or internationalization.

Figure B6.1.1 Stakeholders in internet governance

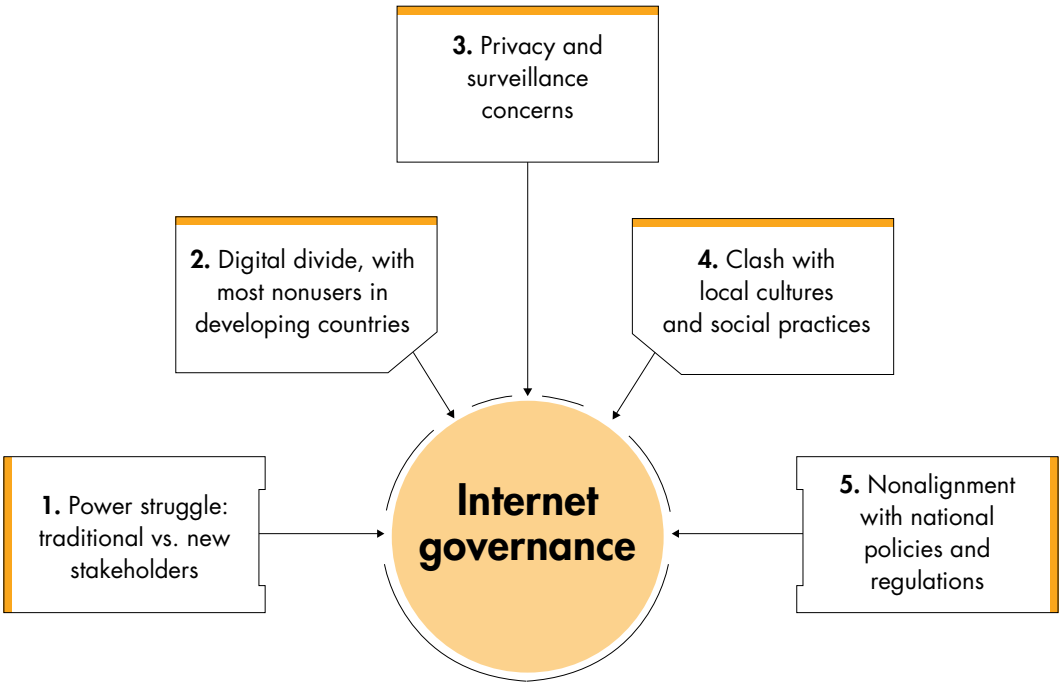


Source: Center for Democracy and Technology, Internet Governance Forum, Athens.

Note: CERTs = computer emergency response teams; COE = Council of Europe; ICANN = Internet Corporation for Assigned Names and Numbers; IETF = Internet Engineering Task Force; ISPs = internet service providers; ITU = International Telecommunication Union; W3C = World Wide Web Consortium; WIPO = World Intellectual Property Organization.

Sources: World Summit on the Information Society 2005, Tunis Agenda for the Information Society, Document WSIS-05/TUNIS/DOC/6(Rev. 1)-E, 18 November: Paragraphs 31, 33, 35; Kummer 2013; Gasser, Budish, and West 2015.

Figure 6.1 Concerns that have fueled the debate on how the internet is governed



Source: Dutton 2015, for the WDR 2016.

Table 6.1 Multistakeholderism or multilateralism

Dimension	Multistakeholder	Multilateral/intergovernmental
Leading principle	Collaborative leadership among stakeholders, with a commitment to resolving particular problems	Sovereign right of governments to determine internet policy and regulation
Representation of stakeholders	Direct engagement of private business and industry, governments, bilateral and multilateral international institutions, civil society and academia, NGOs	National government agency represents interests of all in bilateral and multilateral treaties and agreements, anchored in advice and consultation with all stakeholders
Role of governments	Governments are a key stakeholder, with legitimacy to make decisions	National governments represent other interests in an intergovernmental entity
Process	• Bottom-up participatory • Horizontal across stakeholders • Generally open and transparent	• Top-down consultative • Hierarchical within states and through international agreements and treaties • Intergovernmental negotiations, with open consultation
Examples of relevant bodies and processes	ICANN, Internet Society, World Summit on the Information Society, Internet Governance Forum	ITU, UN, WIPO, WTO

Source: Adapted from Bauer and Dutton 2015, for the WDR 2016.

Note: ICANN = Internet Corporation for Assigned Names and Numbers; ITU = International Telecommunication Union; NGO = nongovernmental organization; UN = United Nations; WIPO = World Intellectual Property Organization; WTO = World Trade Organization.

- More countries are asserting national policy and regulation over areas (mainly around content) that they feel the existing governance structure is not addressing.[9]

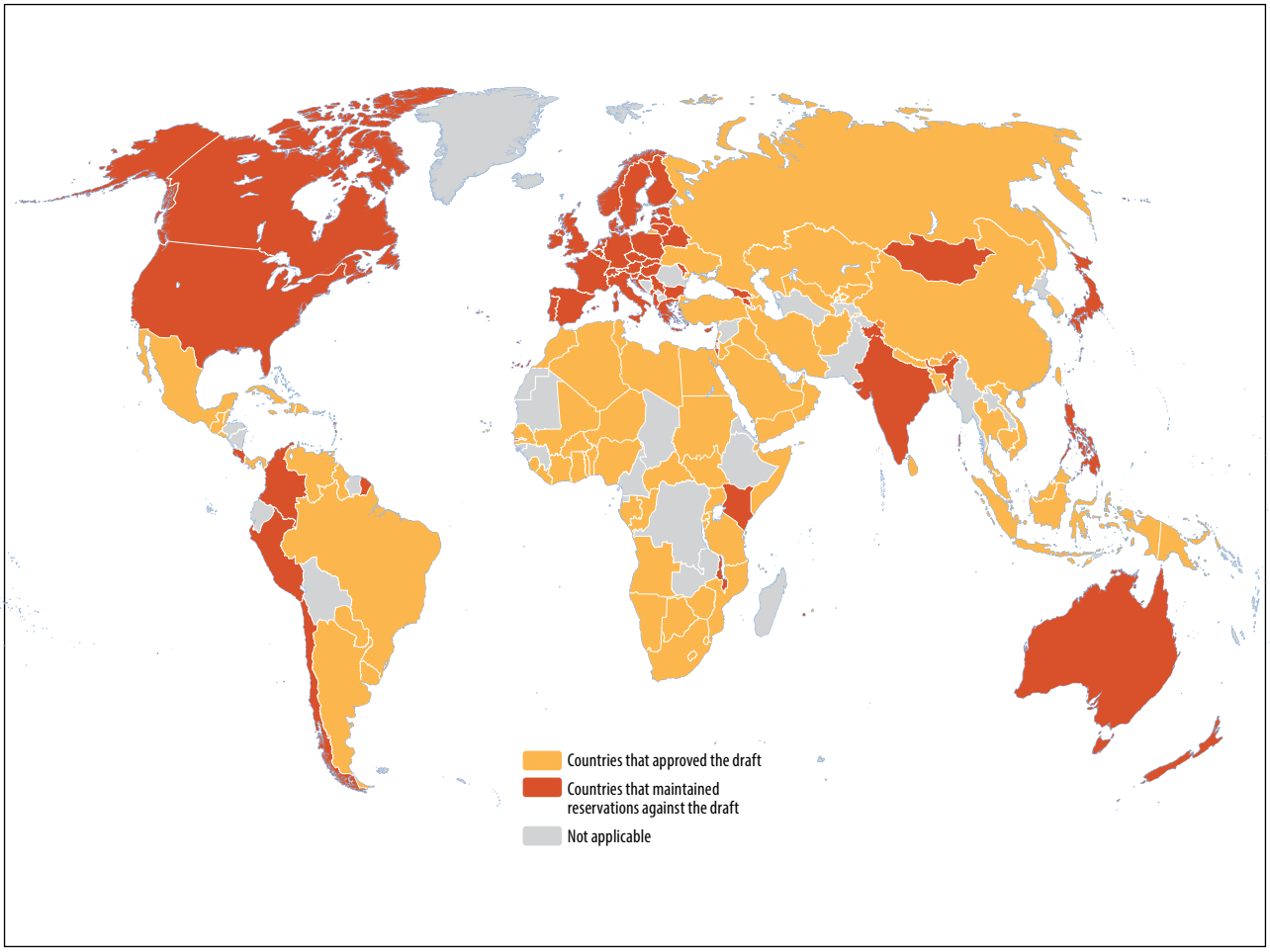
As a result, support for the MSM is not unanimous. Tension between the MSM and a multilateral model (MLM) that puts governance responsibility predominantly in the hands of nation-states has arisen many times since the World Summit embraced MSM. Some governments worry about surrendering sovereignty or asserting national jurisdiction over internet activities within their borders. In September 2011, China, the Russian Federation, Tajikistan, and Uzbekistan jointly submitted a draft resolution to the UN General Assembly on an International Code of Conduct for Information Security outlining their vision of governing the internet.[10]

The promoters of MSM argue that state control of the internet would not leave space for the range of players currently involved in internet governance and could pave the way to suppression of privacy and rights of free expression—say, in the name of national security (table 6.1). Without the checks and balances available through the MSM, abuses might increase. The UN has asserted that rights already protected in the real world—the right to privacy and the right to communicate (to receive and impart information)—are to be protected in the virtual world.[11]

More recently, a new approach to revive the multilateral model arose in an attempt by the membership of the International Telecommunication Union (ITU) to update the International Telecommunication Regulations (ITRs) at the World Conference on International Telecommunications (WCIT) in Dubai in 2012. Measures aimed at regulating privacy and free speech were introduced in a special codicil in the regulations. This resulted in a clear split between 89 countries that approved the new draft and 80 that maintained reservations (map 6.1).[12] Although it was expected that these issues might have been taken up at the ITU Plenipotentiary in Busan, Republic of Korea, in 2014, they were not and remain unresolved.

A key point of contention for countries favoring a multilateral approach is the U.S. government's oversight of IANA (Internet Assigned Numbers Authority).[13] The MLM would like to see an IANA transition to an intergovernmental body, like the ITU. The MSM, especially the United States, insists on further autonomy of ICANN and IANA. In March 2014, the U.S. Department of Commerce announced a process to relinquish its oversight over certain technical functions performed by IANA to the multistakeholder community—in shorthand, the IANA transition, originally scheduled to be completed by September 2015.[14] A key condition of the IANA transition is that oversight of the technical functions would not be ceded to a government or group of governments, but to the multistakeholder community.

Map 6.1 A divided world: Country positions on the International Telecommunication Regulations



IBRD 41790

Source: International Telecommunication Union. Data at http://bit.do/WDR2016-Map6_1.

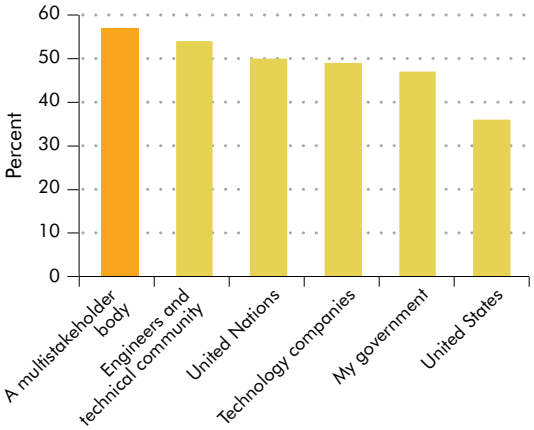
Protecting the interests of users is paramount

This inability of internet stakeholders to reach a consensus on future governance mechanisms could be costly. The lingering uncertainty is likely to affect the private sector's long-term investment planning. Delay in agreeing on new protocols and standards could slow the pace of innovation. Some have even suggested that the internet is at risk of being split, so that the world ends up with several local internets—Google CEO Eric Schmidt calls it the *splitnet*—destroying the essential global character of the internet.

The new governance structure of the internet needs to accurately reflect the plurality and the multifarious nature of internet actors and be flexible enough to accommodate its rapid and continuous evolution.[15] The MSM model is evolving, and that is one of its great strengths. However, care should be taken to ensure respect for principles of good governance (including transparency, accountability, inclusiveness, and representativeness); safeguard meaningful dialogue among stakeholders; empower stakeholders to participate effectively across groups; and prevent capture by special interests.[16] According to one recent survey in 24 countries, the MSM is also the preferred governance model of end users (figure 6.2). It is therefore likely that a multistakeholder format—one that addresses the concerns over the digital divide and trust and use of the internet; provides meaningful forums for "left out" stakeholders; and balances universal community acceptance with appropriate local flexibility—could be the accepted way forward.

Figure 6.2 The multistakeholder model of internet governance enjoys greater support than other options

Percentage of respondents who said they would trust the governance options below completely or somewhat



Source: CIGI and Ipsos 2014. Data at http://bit.do/WDR2016-Fig6_2.

Toward a global digital market

One of the advantages of the internet is its ability to deliver digital goods to a global market, unconstrained by national infrastructure—enabling developing country citizens to enjoy the same products as their peers in the rest of the world. Digital transactions will continue to increase as the number of goods and services offered online increases. For example, with the introduction of online music stores in many developed countries in 2004, digital music started to gain a share of global music sales—from 2 percent in 2004 to 46 percent in 2014.[17] Access to a global market can be particularly advantageous to firms in small, island, and landlocked countries, as well as for countries with small populations, where the size of the local market is often constraining growth.

Digital trade is potentially global in scope, but barriers to digital integration prevent firms from reaching appropriate scale (box 6.2). Issues such as trade logistics and infrastructure, online payment systems, and trade barriers can be handled by national governments (chapter 5). But cross-border issues affecting digital trade need international coordination. Indeed, the internet's ability to seamlessly deliver digital goods and services around the world is considerably impeded by various regulations that could be streamlined through greater international cooperation. The two main cross-border issues are barriers to data flows and uncoordinated intellectual property rights regime.

Removing barriers to cross-border data flow

The internet has revolutionized the way data are collected and shared. This in turn has increased economic efficiency and productivity, improving welfare and

Box 6.2 European Union: A fragmented market for digital products

Despite being a single market with a free flow of goods, services, and people for many decades, the European Union (EU) still functions like a fragmented market for digital goods and services. Consumers and firms face difficulties in engaging in the digital economy.

Consumers in the EU prefer to shop from online stores that are within their national borders. While 44 percent of consumers made an online purchase from a domestic business in 2014, only 15 percent did so from a business in another EU country.[a] The consumers may have concerns about payment security, product quality, or the reliability of the sellers located in another country (figure B6.2.1). Moreover, consumers in the EU face different prices for the same online goods and services because of the practice of geoblocking, in which services and prices are limited to a geographic location. Consumers are directed to their local websites, where they face different prices from online retailers based on their location. Content like video is also restricted within a single geographic location.

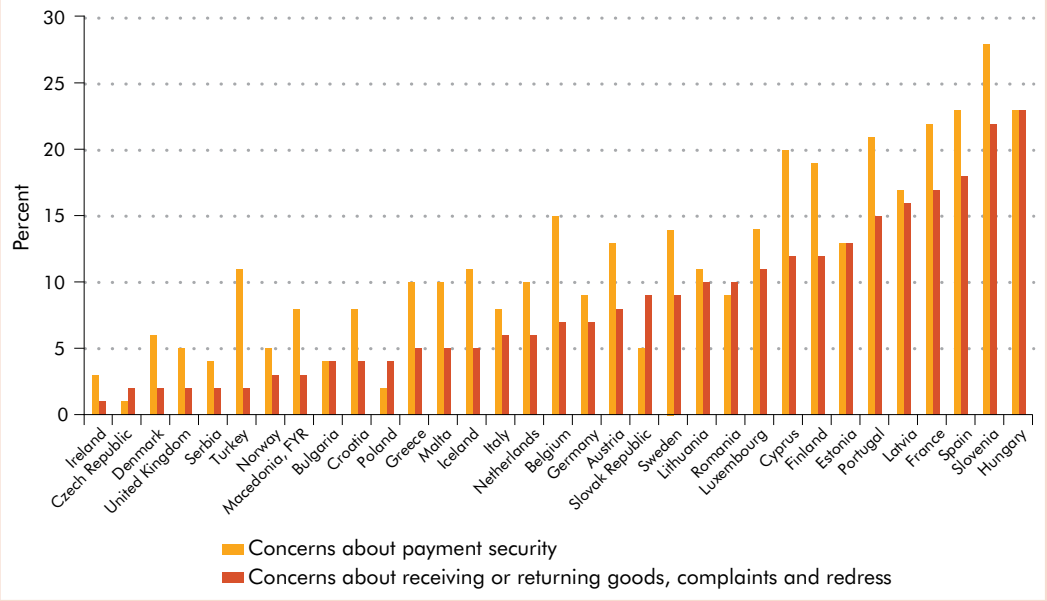
Firms within the EU also face many difficulties in selling their goods and services online in other EU markets. Firms engaging in e-commerce face high and uneven cross-border delivery charges, which are passed on to consumers. For example, Copenhagen, Denmark, and Malmo, Sweden, are separated only by an 8-kilometer bridge, but a package sent from Copenhagen to Malmo costs €27 whereas a package sent from Malmo to Copenhagen costs €42.[b] Moreover, firms face large costs to adapt to various national laws, and believe that the costs outweigh the benefits of setting up a website (figure B6.2.2).

(Box continues next page)

Box 6.2 European Union: A fragmented market for digital products *(continued)*

Figure B6.2.1 Perceived barriers to buying over the internet in 2009

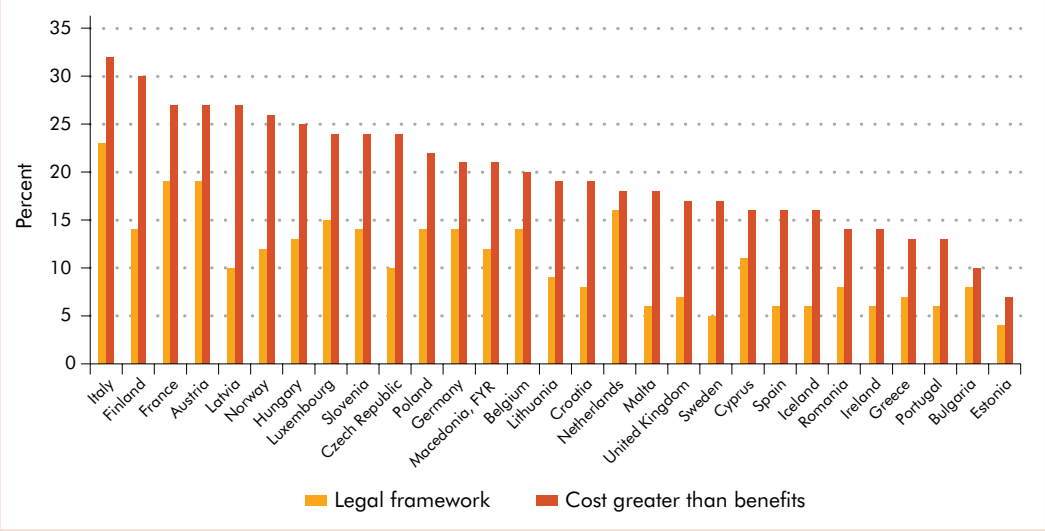
percent of individuals responding



Source: Eurostat. Data at http://bit.do/WDR2016-FigB6_2_1.

Figure B6.2.2 Obstacles for enterprises not selling online in 2013

percent of enterprises responding



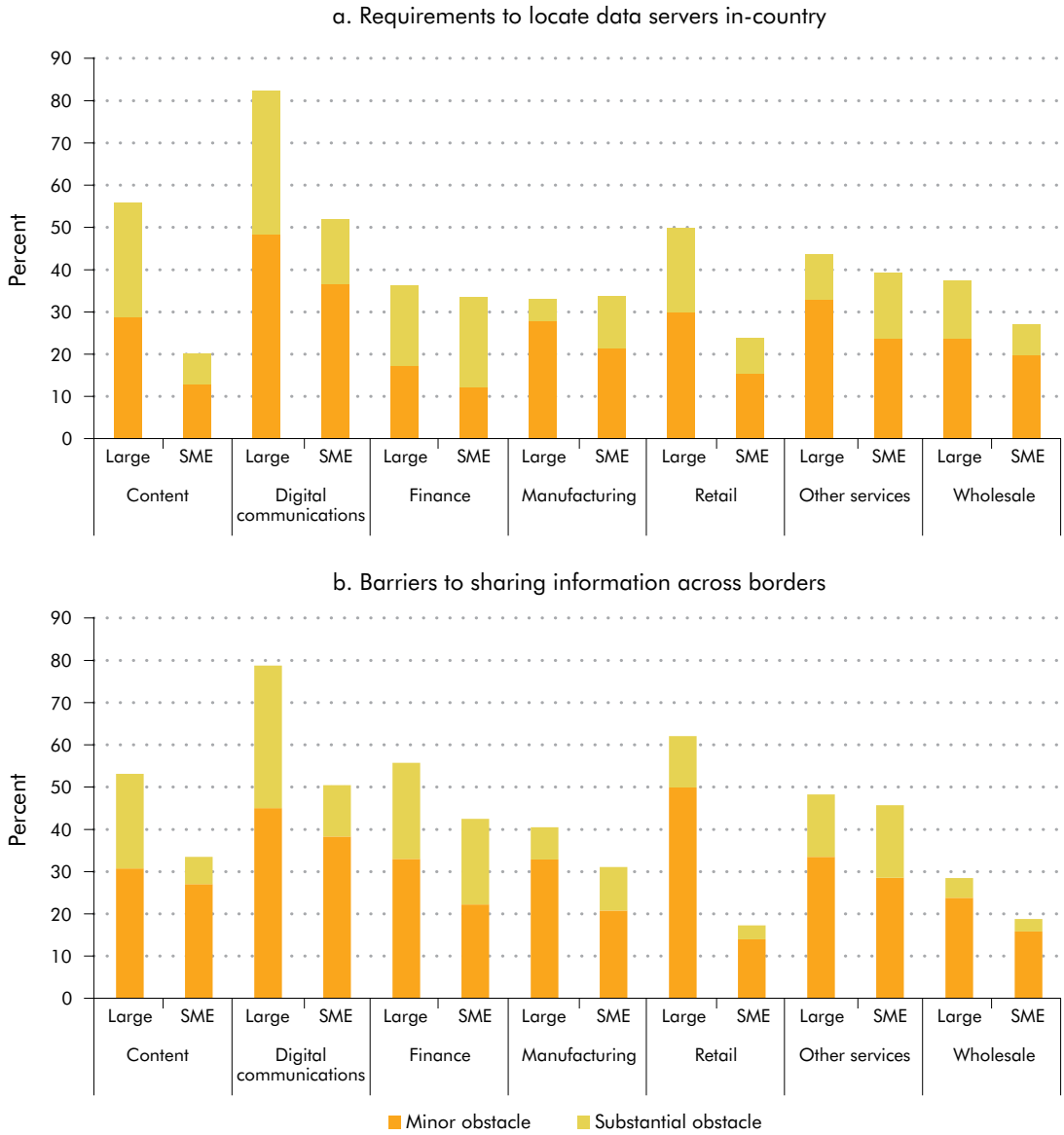
Source: Eurostat. Data at http://bit.do/WDR2016-FigB6_2_2.

a. European Commission (EC) (2015).
b. Figures given by Andrus Ansip, the European Commission vice president for the digital single market. See http://www.politico.eu /article /cross-border-delivery-costs-pose-problems-for-small-businesses/.

raising standards of living. Barriers to data flows prevent countries from benefiting fully from the internet, increasing costs and inefficiencies for firms and individuals. Firms require free flows of data across national borders to operate internationally. This is increasingly important with production being fragmented into global value chains and the digitization of goods and services. Firms move data internationally to control and coordinate their international operations, maintain an efficient supply chain, and manage human resources, production, and sales. The data can range from personal information about employees and customers to production and technical data. The emerging use of cloud computing and the "internet of things" (see spotlight 6, "Six digital technologies to watch") will increase the need for freer data flows. In a survey of U.S. firms in 2012, a large share of firms felt that data localization requirements and privacy

Figure 6.3 Perception of U.S. firms on barriers to data flows as obstacles to trade, 2012

percent of firms responding



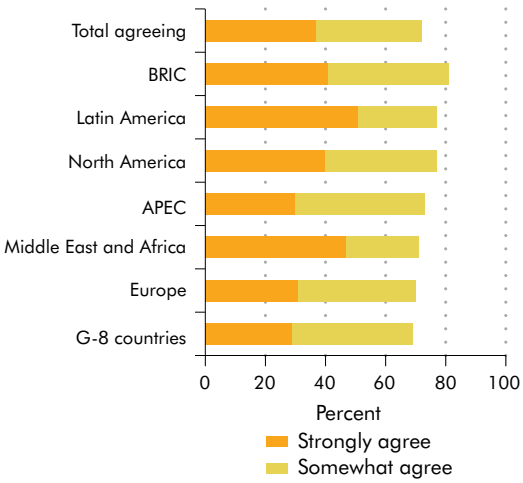
Source: USITC 2014. Data at http://bit.do/WDR2016-Fig6_3.
Note: Large firms are classified as firms with more than 500 employees. SMEs (small and medium enterprises) are firms with more than 20 employees and less than 500 employees.

requirements have emerged as substantial obstacles to trade (figure 6.3). Many of these firms operate globally and have business models that depend on free access to data about their users.

In contrast to industry preferences for open data flows, many countries are beginning to insist that data should reside within their national borders—often referred to as "data nationalism"—and are imposing barriers on cross-border flows of data. So-called data localization requirements require firms to locate data servers and data centers within the country to store and process the information. Other countries have strict regulations about data leaving their borders to protect privacy, reflecting the preference of their citizens, as users become more cautious and risk averse to how their data are being used for commercial gains (figure 6.4). Barriers to data flows can affect trade more than an increase in tariffs: they can prevent firms from entering or operating in a sector, while tariff rates merely impose an additional cost to operations that can be absorbed by the firm or passed on to customers.

Cross-border data flows, which are essential to international trade, are a substantial portion of data traffic, comprising about 16–25 percent of U.S. data traffic and 13–16 percent of European data traffic.[18] Cross-border data flows are likely to increase with the increasing use of cloud computing, which relies on data flowing back and forth as users retrieve and update information directly on the servers. Barriers to data flows will force firms to relocate tasks and operations, change their information technology (IT) architecture, engage a different supplier, or discontinue services to customers. These barriers disrupt two of the most important business trends facilitated by the internet: the fragmentation of production into global value chains, and the creation of offshore service hubs like the business-processing operations in India or the Philippines.

Figure 6.4 A majority of respondents agree that their online data and personal information should be physically stored on a secure server in their own country



Source: CIGI and Ipsos 2014. Data at http://bit.do/WDR2016-Fig6_4.

Note: APEC = Asia-Pacific Economic Cooperation; BRIC = Brazil, Russia, India, China; G-8 = Canada, France, Germany, Italy, Japan, the Russian Federation, the United Kingdom, and the United States.

The estimated effects of barriers to cross-border data flows are significant. An economic simulation conducted by the European Centre for International Political Economy (ECIPE) considers the proposed or enacted legislation on data flows in six developing countries and the EU and calculates the costs of regulations on businesses.[19] The countries examined are proposing a mix of regulations in their legislative packages that will impose stricter privacy regulations, such as the right to be forgotten and the consent to transfer data to a third party (table 6.2). The study finds that these laws can reduce gross domestic product (GDP) by up to 1.7 percent, investments up to 4.2 percent, and exports by 1.7 percent (figure 6.5).[20]

The argument to remove all barriers to data flows, however, is not as clear-cut as the arguments to remove barriers to cross-border trade and investment. Government regulations to place data servers in the country or to prevent information from being shared across borders can stem from legitimate concerns about privacy and security for their citizens' information. Countries may believe that imposing data localization and privacy requirements will allow them to better protect the data in their country. But it is not always clear whether the data are more secure in a local data server or in a dedicated secure server overseas. Moreover, data localization requirements might threaten the progress of new technologies that depend on unhindered cross-border data flows such as the internet of things, "big data," and cloud computing.

While countries may have legitimate reasons to impose barriers to data flows, these barriers should not be a disguised method to impede trade and economic activities. By imposing barriers on data flows, countries may mistakenly believe that they can encourage domestic data-driven sectors, like cloud service providers. Such policies are akin to import substitution strategies, which have had a mixed record. Moreover, the barriers should not treat firms differently according to their ownership, as that would reduce competition and slow down digital adoption in the rest of the economy (chapter 1).

Table 6.2 Many countries have proposed comprehensive legislation on data flows

Proposed requirement	Brazil	China	EU-28	India	Indonesia	Korea, Rep.	Vietnam
Data localization requirement	No	Yes	No	Partial	Yes	Partial	Yes
Consent required for data collection	Yes	Yes	Yes	Yes	Yes	Yes	No
Consent required for transfer to third parties	Yes	Yes	No	Yes	No	Yes	No
Right to review	No	No	Yes	Yes	Yes	Yes	No
Right to be forgotten	Yes	Yes	Yes	No	No	Yes	Yes
Breach notification	No	Yes	Yes	No	Yes	Yes	No
Impact assessment	No	Yes	Yes	No	No	No	No
Data privacy officers	No	No	Yes	No	No	Yes	No
Sanctions for noncompliance	Yes	Yes	Yes	Yes	Yes	Yes	No
Government access required	Yes	No	No	Yes	No	No	Yes
Data retention requirement	Yes	No	No	Yes	No	No	Yes

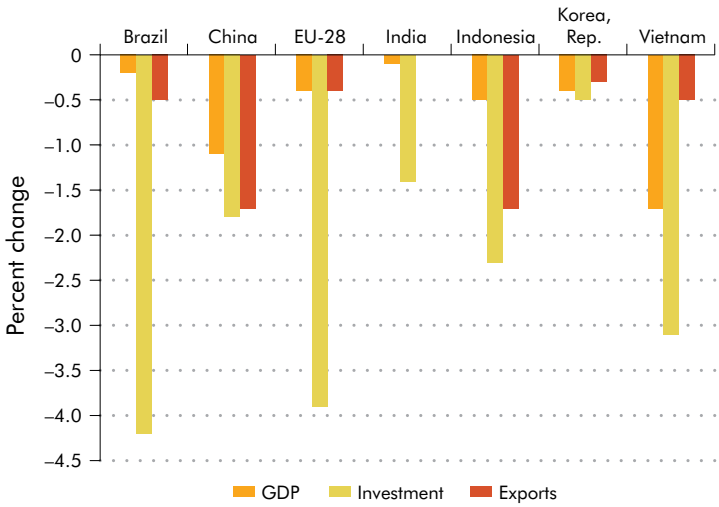
Source: Bauer and others 2014.

Note: EU-28 = current member countries in the European Union.

While these barriers remain, developing countries participating in global markets should ensure that they are not excluded because of weak or absent regulations. At a minimum, countries should enact data protection regulations following internationally recognized principles so that multinational companies do not avoid the country because of uncertainty about compliance and trust in the handling of data.[21] For example, the EU allows personal data to leave its borders if countries have "adequate" protection for personal data. Australia allows data to leave its borders only to those jurisdictions with substantially similar levels of privacy protection. However, these regulations continue to evolve, and countries must constantly adapt to such changes to reduce the uncertainty and compliance costs on companies.[22]

Recognizing the importance of cross-border data flows, many countries have agreed on basic principles to coordinate their data regulations, as with the recently revised Privacy Guidelines and Declaration on Cross-Border Data Flows by the Organisation of Economic Co-operation and Development (OECD), or the Privacy Framework of the Asia-Pacific Economic Cooperation (APEC). Other efforts focus on ensuring that companies that move data across borders have rigorous internal policies to maintain the privacy and protection of the data. In the absence of international coordination on privacy rules, other solutions are being sought that rely on companies' internal policies to protect privacy, such as the EU's Binding Corporate Rules and APEC's Cross-Border Privacy Rules. While these programs help facilitate cross-border data flows, the rules may be too cumbersome for most firms and implicitly benefit larger firms.[23]

Figure 6.5 Changes in GDP, investment, and exports due to regulatory restrictions on data flows



Source: Bauer and others 2014. Data at http://bit.do/WDR2016-Fig6_5.

Note: The figure shows percentage changes according to simulations using a GTAP model. EU-28 = current member countries in the European Union; GTAP = Global Trade Analysis Project.

Setting global standards on data exchange

Standard setting can be another tool to reap digital dividends. Data exchange standards, for instance, can greatly facilitate cross-border services and enable a seamless flow of information (see spotlight 5, "The data revolution"). Various ongoing initiatives look at setting data exchange standards in certain sectors at the international level. The standard should also be open, and use publicly available platforms and software, so that it does not exclude firms. One example is the GS1 system of standards used in transport and

logistics. The GS1 assigns a global unique number so that any firm can identify and share product data with its trading partners. The number allows anyone to trace the origins of the product up the supply chain and track its movement downstream.

Data exchange standards are being promoted in the context of Open Data by international organizations. Examples include the Comprehensive Knowledge Archive Network's (CKAN) standards—already adopted by more than 40 governments and organizations, such as the governments of the United Kingdom and Uruguay and the EU—and the Open Data portals for Africa and Bermuda. Progress has also been made in developing data exchange standards for geospatial information (such as the EU INSPIRE directive) in the electricity sector, particularly for smart grids, and in the health sector.

Countries should consider joining ongoing international efforts for standard setting for data exchange, and expanding them to other areas, at least for critical sectors. Data exchange standards, however, are not a silver bullet; they need to be accompanied by appropriate policies and actions to have some effect on the digital market. For e-freight, the International Air Transport Association (IATA) has been working on setting data exchange standards and has identified actions that need to be in place for these initiatives to succeed.[24] One is the requirement that public institutions (such as customs for e-freight) accept electronic documentation as an alternative to paper-based documentation. Another is that all relevant actors need to be involved and act in a coordinated fashion (such as customs, security, and transportation). And third is an end-to-end supply chain vision and e-document, as well as common business processes that are aligned with international standard-setting bodies such as the World Customs Organization, the United Nations Centre for Trade Facilitation and Electronic Business, and the International Civil Aviation Organization.

Better coordination of intellectual property rights regime

The internet allows people to purchase products and access vast amounts of content and information, whether protected by intellectual property rights (IPRs) or not, leading to allegations of IPR infringements. IPR infringement presents a risk to consumers who might purchase counterfeit goods, and a disincentive for firms and artists to create new products and content.[25] National IPR regimes allow firms to protect and use their intellectual property. But having different IPR regimes and multiple IPR registrations, in different countries creates problems for firms selling in global markets. Firms must seek recognition and enforcement in each jurisdiction. Similarly, if a firm wants to use an IPR it does not own to produce a digital good or service, it must apply for licenses in each country in which it wants to sell. While there are international treaties governing recognition and protection across member countries, each jurisdiction has different rules and requirements, depending on the type of IPR. Navigating these IPR regimes is confusing and creates large administrative costs for firms. These costs can even prevent firms from entering new markets.

Firms operating in the global market face huge costs to apply and use IPRs across borders. For example, in order to protect an IPR, a separate patent application is needed in each country where protection is sought. A patent application that is valid in the EU costs at least five times more than an application in the United States.[26] The scattered nature of the IPR regime can add complications for firms when they need to identify the rights holders and construct a new business model. In particular, the firm offering a digital good or service over the internet needs to apply for a copyright license, patent, or trademark in each market it serves, and then must be ready to enforce it under each national regime. The complexity and costs of doing so can discourage new market entrants. Only larger firms will be able to bear those costs and reap the benefits from the internet.

Countries should make it easier for firms to protect their intellectual property rights, thus stimulating more innovation and creative sectors. The regulation process to apply for intellectual property licenses should also be harmonized and streamlined. The Patent Cooperation Treaty allows firms to file an international patent application, but this just creates a standardized application for the firm that must still be submitted to national authorities. Going one step further would be preferable. For instance, under the World Intellectual Property Organization's Madrid Protocol, firms need only register their trademark in any signatory country and it will be protected across member countries. Similarly, it should be easier for firms to obtain licenses to certain IPRs that will allow them to operate globally. The availability of an online licensing system for intellectual property rights can reduce the administrative burden to firms.

National IPR regimes should extend beyond the laws defining and protecting the intellectual property (IP). Countries need a broader public sector IP strategy, which considers how policies and regulations in tax, education, science, technology, and industrial policies can not only make it easier for firms to protect their IPRs but also help to stimulate innovation and creative

sectors and benefit the public interest. The availability of an online licensing system for IPRs can reduce the administrative burden to firms. Such an online licensing system requires international coordination and an agreement among many countries. Countries can also allow the concept of "fair use" in intellectual property regulations that permits an individual or business to use the IPR for purposes such as research and education, journalism, and library activities.

Leveraging information for sustainable development

Eliminating global poverty and heading off planetary environmental threats are two of the world's greatest challenges. The costs of action are in the trillions of dollars, making global cooperation essential. But development assistance represents only 0.6 percent of developing country income. How can donors, development agencies, nongovernmental organizations (NGOs), and international organizations hope to make a difference? They can use digital technologies to deploy funds and knowledge more efficiently and to include more people in the process. They can do so in three ways:

- *Getting wired for feedback.* Development projects are often very sensitive to context and have no standard blueprints. They could be more relevant if their design and implementation drew on local knowledge. Projects could be more successful if wired for rapid feedback, allowing continuous improvement by implementers and more effective supervision by funders. National-level policies could be fine-tuned with early information on whether poor people were benefiting. Digital technologies can make these feedback processes much cheaper and easier. But can stodgy organizations and their partners become nimble users of feedback?
- *Taking information to scale: information as an input.* Decision makers from villages to capitals lack the information they need to optimize their actions. Farmers could better manage their fields with timely information about weather, pests, and markets. Ministries could better fight poverty with up-to-date information about where poor people live and their constraints. Land markets and environmental protection could be more efficient with accessible information about the condition and ownership of land. New technologies make it possible to widely and cheaply distribute all this information, supporting better outcomes. But can this succeed over the resistance of those who benefit when information is tightly held?
- *Mustering global information for global goods.* Global weather and water data are costly to gather but now almost costless to distribute. They take on the character of a global public good. Information on weather affecting mountain headwaters helps people prepare for floods or harvests half a continent away. New technologies make it easier to assemble and analyze this information. But who will pay for it? And can countries agree to share it with their downstream and downwind neighbors?

Table 6.3 and figure 6.6 map these information needs onto the landscape of development spending. Some projects are characterized by geographic dispersion, sensitivity to local environmental and social context, and an inherent need for adaptive implementation. These activities could benefit greatly from rich and rapid feedback. Another class of funding involves investments in big infrastructure systems or support for government policies. Here, fine-grained and timely information—on everything from poverty to water consumption to service delivery—could support better decisions on system design and operation. This section explores the potential scope of these benefits and the largely institutional challenges in attaining them. The discussion is unavoidably speculative.

Getting wired for feedback—more inclusive, better, faster data to guide development projects

Feedback on what is working and what is not enables more nimble and effective implementation. In the past, feedback has been thin, slow, and unreliable. Now the technical barriers to better feedback have been overcome. But often organizational inertia prevents the benefits of innovative technologies from being achieved. Revamped structures and incentives point to possible ways forward.

Lack of feedback hampers development efforts

Development agencies committed US$6.8 trillion in project assistance from 1947 to 2012. One would not expect these projects to be universally successful. Development is inherently complex, and development agencies venture into areas that others would not; a high success rate would indicate unambitious objectives. But there is room for improvement in the performance of international foundations, donors, and lenders, whether bilateral or multilateral. About one-third of the recent projects of international financial

Table 6.3 Information as feedback and as input, by expenditure type

Expenditure type	Example	Information as feedback	Information as input
Dispersed and intensive services	Rural primary health, community-driven development	Rapid feedback on service provision, uptake, and impacts	n.a.
Dispersed land and water management	Watershed management	n.a.	Rapid feedback on crop, water, soil, infrastructure, and environmental conditions; information on weather, hydrological and market conditions
Small-scale and dispersed infrastructure	Rural roads and sanitation	Feedback on infrastructure construction, use, condition, and maintenance	n.a.
Large-scale infrastructure	Hydropower	n.a.	Optimizing design and operation of power and water systems
Policy design	Educational policy design	n.a.	Fine-grained, timely information on economic and social conditions for policy design
Institutional development	Legal and judicial development	Feedback on institutional capacity and performance	n.a.
Budget support	Development policy loans	Timely and fine-grained feedback on impacts of policy implementation on income distribution, service delivery, environmental conditions	Strategic planning for the Sustainable Development Goals

Source: WDR 2016 team.

Note: n.a. = not applicable.

institutions are deemed unsuccessful by the institutions themselves (figure 6.7). What goes wrong?

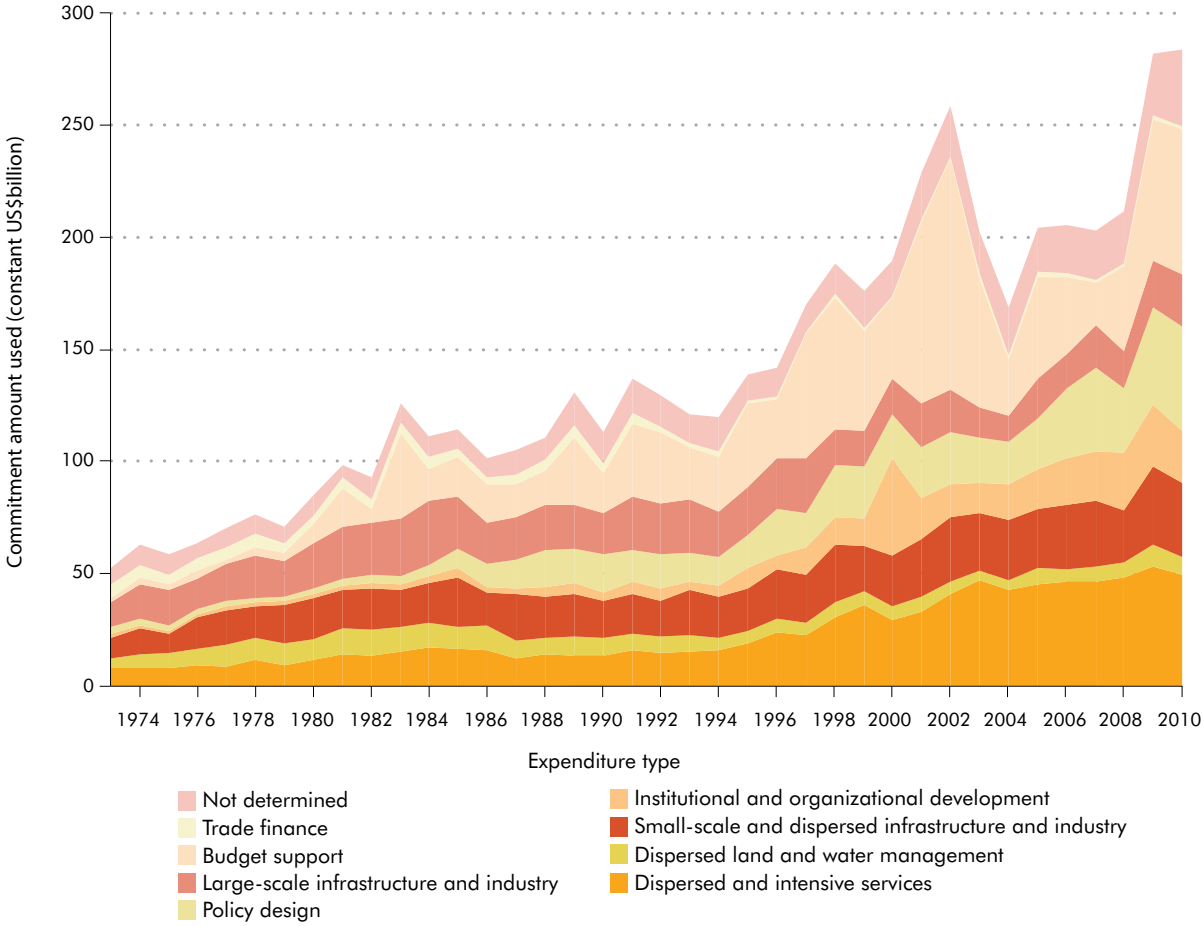
Critics paint development practice as inflexible, ineffective, and out of touch.[27] Too much emphasis on spending rather than on results, they say. Project designs are cooked up by development experts and government officials, in this view, and often do not reflect local preferences, insights, or political realities. They can be further hampered by lack of rigorous, systematic learning about the success or failure of prior projects. Without reliable information on project effectiveness, flashy bad ideas go viral while subtle good ones languish. With such poor design, projects can go off the rails. And if they do, there is often no fast channel for feedback and course correction.

A combination of rigid design and poor feedback might be particularly lethal for "complex" and context-sensitive projects, where workable solutions require experimentation.[28] Consider health services, where success depends on changing the culturally rooted behavior of clients and staff—or watershed management, where social and environmental conditions vary from one valley to the next.

Yet there is a paradox: monitoring and evaluation (M&E) improves performance, but agencies underinvest in it. The correlation between a project's outcome and the quality of its M&E is stunning. Figure 6.8 (based on data from the World Bank, the only official donor agency that publishes this information in this detail) shows that the few projects with high-quality M&E are almost all rated "satisfactory" or "highly satisfactory" in outcome; the larger number with "negligible" M&E are mostly rated "moderately unsatisfactory" or worse. Evaluations suggest a strong causal link: a good M&E system supports clear formulation of objectives, and M&E detects and solves problems in implementation.[29] Despite this, an OECD survey[30] of 28 donors finds pervasive shortcomings in their M&E systems. A majority of the donors report incomplete results frameworks, difficulty in tracking outcomes, and a view by partners that a results framework is a formal requirement rather than a useful tool. Feedback loops are reportedly lacking. NGOs echo these views. Many donor staff and recipients see M&E as a burdensome "extractive industry," generating information that satisfies some distant funder's accountability requirements but does not serve the needs of project managers or beneficiaries.

Worse: learning is slow. The multilateral development banks have independent evaluation units for both accountability and for learning—an important source of objective feedback. But these units do not

Figure 6.6 The evolution of development aid by information needs, 1973–2010



Source: WDR tabulation from AidData (http://AidData.org). Data at http://bit.do/WDR2016-Fig6_6.

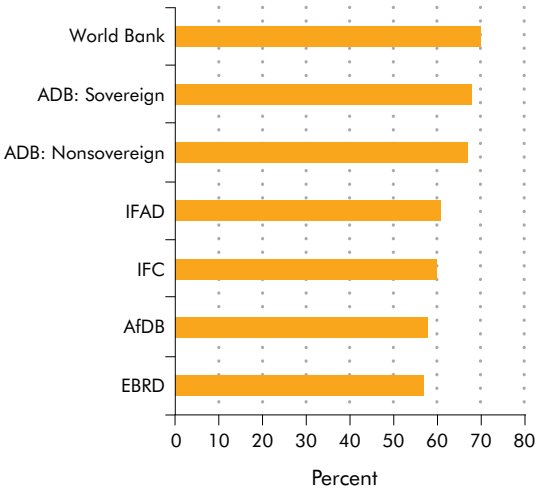
have resources to review every project in depth. They also focus on after-the-fact evaluations to avoid conflicts of interest. This slows feedback: at the World Bank, the average lag between project approval and evaluation is 7.5 years.

Technology enables feedback for agile implementation and learning

New technology should make M&E even faster, cheaper, and more effective. A poster-child example is the World Bank–backed Sujala project in Karnataka, India, which employed a technology-intensive M&E system operated by the Indian Space Research Organisation.[31] This combined remote-sensing imagery with household surveys and sophisticated data systems for management and geographic information. Detecting that benefits were not being focused on the poorest groups, the project fixed the problem. It rigorously demonstrated a 24-percent increase in average incomes, together with environmental improvements, and helped shape the revised national watershed guidelines.

Computer-assisted surveying—by mobile phone or by tablet-wielding field agents—now enables much faster and more reliable assembly and use of information on the progress of projects. A nascent example is the Social Observatory, a pilot that embeds a variety of feedback systems into a multibillion dollar program on rural livelihoods—precisely the kind of complex program noted earlier. The Observatory fields rigorous but slow randomized controlled trials to determine whether particular phases or elements of the program had the desired impact. It supports internet-connected management information systems, wired from the village up, that allow program managers at the district or state level to detect and correct anomalies in performance. Perhaps most interesting, it supports a beneficiary-designed survey, administered

Figure 6.7 Proportion of international financial institution projects with successful outcomes



Sources: Based on most recent available reviews of independent evaluations or independent validations of self-assessments. Data at http://bit.do/WDR2016-Fig6_7.

Note: ADB = Asian Development Bank; AfDB = African Development Bank; EBRD = European Bank for Reconstruction and Development; IFAD = International Fund for Agricultural Development; IFC = International Finance Corporation. "Outcome" is an index combining efficacy, relevance, and efficiency. "Success" is a rating of 4 or better on a 6-point scale (IFAD, IFC, World Bank); 3 or better on a 4-point scale (ADB, EBRD); or 2.5 or better on a 4-point scale (AfDB).

by locally recruited women using a tablet computer. The annual survey, planned for 1 million respondents, aims to provide actionable feedback at all levels from village to state (box 6.3).

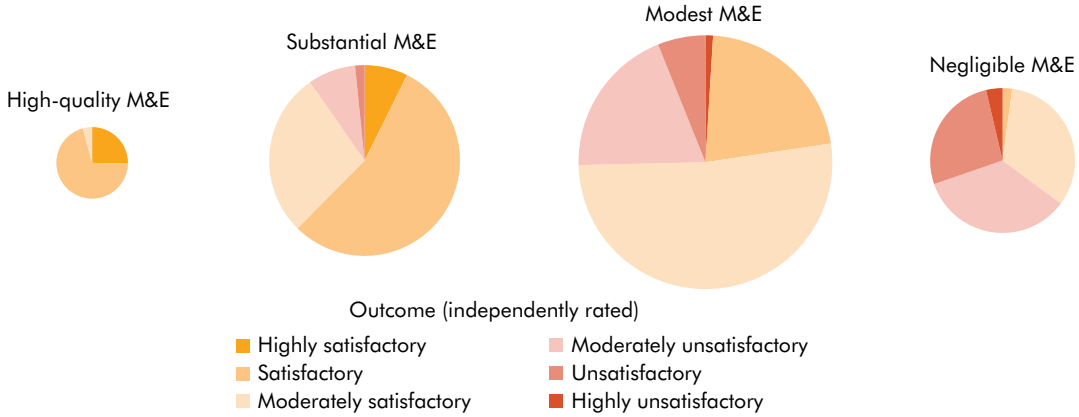
Feedback is facilitated for programs that are built around data platforms. For instance, the Bridge International Academy in Kenya monitors teacher and student performance, allowing management to intervene when teachers, students, or schools are underperforming (see chapter 3). Bus rapid transport systems can automatically monitor vehicle speed and ridership, tracking maintenance, capacity use, and responses to weather. Health systems can track use and outcomes if patients and providers use digital ID cards to log services. Remote sensing can track program impacts on agriculture, water use, deforestation reduction, or air pollution. Ground sensors can track the sustainability of infrastructure in remote and conflict-affected areas, as in Afghanistan and Pakistan. These systems offer rich, representative, actionable real-time information.

Organizational inertia impedes agile, feedback-intensive approaches

These techniques are technically feasible, but are they organizationally feasible? One obstacle is a skills gap, but this can be remedied through training. Obstacles posed by incentives are more formidable. First, donor agencies, their staff, and their recipients are often focused more on maximizing disbursements than on optimizing results. Disbursements are more immediately linked to organizational power and survival, and have traditionally been much easier to track and manage.

Second, organizations cling to procedures that assume that projects can be thoroughly planned in advance and in detail. According to an OECD survey, "Development practitioners report being constrained by rigid results frameworks that are not flexible enough to include new sets of information to adapt to

Figure 6.8 High-quality M&E improves project outcomes



Source: WDR 2016 team based on World Bank data. Data at http://bit.do/WDR2016-Fig6_8.

Note: Colors code the proportion of projects by outcome. The size of the circle is proportional to the number of projects in the M&E category. M&E = monitoring and evaluation.

Box 6.3 The Social Observatory and P-tracking

"Do you decide on what types of clothes to wear based on your own preferences?" That's a question on a survey instrument to assess whether Tamil Nadu's Empowerment and Poverty Reduction Project (part of the Pudhu Vaazhvu Project, or PVP) is actually having an impact on women's empowerment. For project beneficiaries, it was a touchstone indicator of empowerment.

That may be because it was crafted by a group of the women the project is designed for.

The Social Observatory seeks to build diagnostics and feedback loops into the implementation of PVP and similar livelihood projects in India. These are complex projects, operating in hundreds or thousands of locations. They have multiple objectives and lots of moving parts: job training, loans for small-scale income-generating activities ranging from dairy production to sanitary napkin manufacture, even self-defense classes. So it is hard to get a fix on what is going on without a lot of information. To provide useful feedback, the Observatory deploys a variety of tools, including randomized controlled trials, internet-connected management information systems, and "P-tracking," the participatory approach to monitoring.

P-tracking builds on a few innovations. First, as the name suggests, the survey instrument was designed in a participatory fashion with a group of beneficiaries to ensure that the information is seen as relevant. Indeed, the women report that the acts of administering and responding to the survey helped change perceptions. (The survey is not village-specific; after testing, it was standardized for statewide use.) Second, it is administered by local staff, not by some external contractor. Third, it informs higher-level project management but also provides actionable information at the village level.

Digital technologies help. The surveys are administered using tablet-based software, and the data are pooled through village-based internet connections. (These, by the way, also allow villagers to buy train tickets, pay electric bills, and check school exam scores without hours-long queueing or travel.) Automating the survey makes it easier to train the local interviewers. It is difficult to imagine how the Social Observatory could realize its goal of scaling up to 1 million respondents, and providing timely annual information, using traditional paper-based surveys.

Most interesting, the Observatory tackled ways to make this massive information set digestible, a problem facing all producers of data, big or small—and a particularly challenging problem when many users are illiterate. The Observatory commissioned an interactive graphical display that allows a village to compare its performance with neighbors, catalyzing healthy competition.

Like so many promising ideas covered in this report, P-tracking is still in a demonstration phase. About 40,000 interviews have been completed in a pilot district, and it will be a big leap to cover the projected million. Another challenge will be to mainstream annual P-tracking data into project implementation at all levels. Information supply is just half the battle.

Source: WDR 2016 team; http://www.worldbank.org/en/programs/social-observatory.

changing contexts and emerging challenges."[32] Third, when funders—such as taxpayers—cannot directly observe results, there can be a conflict between accountability and learning. The OECD survey notes that "results data for accountability purposes tend to emphasize the positive," getting in the way of learning. Ninety percent of the agencies surveyed reported difficulties in using results for accountability. In sum, as seen also in chapter 3, rapid feedback may be technically feasible, but it will have limited impact unless there is willingness to accept it and flexibility to act on it.

A focus on results and learning can shift incentives toward demand for information

Thus the key to technology effectiveness is, once again, in the analog world—in institutional structures and incentives that elevate feedback and learning. Many private companies, and some development agencies such as the Bangladeshi-based development organization BRAC, already have cultures that do this. For others, culture change will be a challenge. Traditional and nontraditional agencies are experimenting with ways to make their business more agile—ways that are untried and carry risks as well as promise.

One approach concentrates on inclusion—bringing in feedback and ideas at the design stage so as to combine global technical expertise with profound local insights and knowledge. Amplify, an innovation of the U.K. Department for International Development (DFID), tries to build collaborative networks of development practitioners to develop more inclusive proposals for grant funding. It uses online crowdsourcing to suggest and refine ideas, and facilitates

collaborations among distant groups—such as a New York design study and a Nepalese NGO.

Another approach to changing institutional incentives is by pursuing outcome-based aid. This shifts funder and client attention from disbursements to results. Disbursements are made only after achieving pre-agreed outcomes. This should motivate both funders and recipients to rapidly track processes, outputs, and results, introducing the possibility of flexibility in getting those results; a downside is shifting implementation risk to the recipients. The World Bank's new Program for Results (P4R) uses independent verification of outputs and outcomes to motivate countries to beef up their own monitoring systems. In Vietnam, for instance, a P4R sanitation project links disbursements to installations of household toilets. The state audit agency sends out surveyors equipped with smartphones to independently verify, with GPS-stamped photos, a sample of health ministry–reported installations. Beyond simply incentivizing particular outcomes, this approach may catalyze a wholesale shift in P4R clients toward a culture of results, motivating them to invest in real-time monitoring.

More disruptively, development impact bonds have been proposed as a way to use an outcome-based approach to solve agencies' constraints of inflexibility, risk aversion, and short time horizons. In this relatively untried approach, agencies contract with a private party or NGO for the achievement of specified and verified results, potentially over a period longer than most projects. The contractor has the flexibility to decide how to achieve those results—and could profit or lose depending on performance. But the approach's effectiveness will depend on how well specified and reliably measured the indicators are for making disbursements. Poorly specified proxies could produce perverse impacts, as could measurement systems subject to tampering. Digital technologies could make a difference by allowing better measurement and independent verification of the desired outcomes. They could also monitor unexpected social or environmental impacts. And they can be used to collect rich qualitative data as a check against the potential bias of narrowly specified quantitative targets.

Another way to motivate attention to results is by an evidence-based approach to financing, as illustrated by the Development Innovation Ventures initiative of the U.S. Agency for International Development (USAID). Small grants support proof-of-concept pilots. Ideas that have passed the first stage are rigorously evaluated in a second-stage testing phase. Those with demonstrated impact can get large grants for scaling up. Although Development Innovation Ventures is not restricted to digital technologies, many of the supported concepts are based on ICTs or use ICTs for monitoring in the demonstration phase. ICTs could thus speed the more reliable demonstration and dissemination of investment ideas.

To sum up, an alternative vision of development practice starts with incentives. Project or program staff get incentives and flexibility to pursue results. So do beneficiaries. Digital technologies facilitate rapid, real-time monitoring of outputs and outcome results that matter, and provide this information in a comprehensible form to those who can act on it—complemented by systems that assess impacts. Consistent with privacy considerations, these data streams would be made public, as open data. Anyone—program managers, civil society, academics, or auditors—can have access to this information. With many eyes on the information and a profusion of analyses, accountability and learning are enhanced. In this system of *open-source evaluation*, it is important to have an independent group assure integrity of the data system.

Taking information to scale

How can emerging opportunities to build internet-based services make development and environmental management more efficient and inclusive? These services reduce the cost of information as an input, thereby reducing risks or improving decisions—for individuals, for managers of infrastructure networks, and for public authorities. The rationale for involvement by development or international agencies is fourfold. First is a characteristic feature of information services: many of these interventions are expensive to set up and run, but can distribute information at very low marginal cost. So financing becomes problematic. If the service is nearly costless to distribute, then it is efficient to provide it to everyone who might benefit. But the fixed costs must be financed somehow. High fees might exclude poor people; low fees imperil sustainability; price discrimination might be difficult. And if the information can be copied, it may be difficult to get anyone to pay for it. So there is often an argument for public or donor finance. Second, the information often underpins a public good, such as environmental protection or poverty reduction, reinforcing the rationale for public finance. Third, development agencies—including NGOs and foundations—can play a distinctive role not only through finance, but also via capacity building, and support for complementary investments

and policy reforms. Finally, there is a need for international coordination to face planetary issues such as climate change.

What follows are some concrete examples of how information and analytics might be able to boost efficiency at the individual and system level, with implications for the role of development agencies (box 6.4).

Information as an input to individuals

Poor people are often poor in critical information: about the benefits of hand-washing, or tomorrow's weather forecast, or the price their produce will fetch. When information becomes dramatically cheaper, there is a prospect for welfare gains. Some of the clearest and most relevant examples to poverty reduction are in agriculture, which will here serve as an illustration of the wider potential across many aspects of life and the economy.

For tropical maize in Africa, yields are typically only one- fifth of the potential, and for other crops and places in the developing world, yields rarely exceed 80 percent of the potential.[33] Many factors account for this poor performance, but a lack of information—about techniques, weather forecasts, and markets—is a part of the gap. Traditional agricultural extension agencies have tried to fill the information gap, but have depended on in-person farm visits and printed material. Extension agents are typically assigned to serve an impossibly large number of farmers spread over a logistically daunting stretch of countryside, so information flows are low, and do not include customized information based on seasonal and daily weather forecasts.

Pilot programs are beginning to tap the potential of ICTs to reduce costs and increase the reach of extension efforts. Some initiatives in India show

Box 6.4 ICTs and the Sustainable Development Goals

In the year 2000, when the international development community came together at the United Nations (UN) to approve the Millennium Development Goals (MDGs),[a] the digital revolution was just beginning. At that time, there were fewer than 1 billion mobile phones in use worldwide and just 400 million internet users. In the intervening years to 2015, when the MDGs were reviewed, both indicators have grown by more than sevenfold. Thus target 18—*to make available the benefits of new technologies, including ICTs (information and communication technologies)*—was one where progress was easy to show.

But with the new generation of Sustainable Development Goals (SDGs), adopted by the UN in 2015, the bar has been raised. As part of a broader goal 9, on infrastructure, industrialization, and innovation, the SDGs commit to "significantly increase access to ICTs and strive to provide universal and affordable access to the internet in LDCs [least developed countries] by 2020." Given that many developed countries are already close to saturation in terms of mobile penetration, it is logical to focus on internet access, and specifically on the needs of the LDCs. The two key words in the new target are "universal" and "affordable."

Given the current low level of internet penetration in the LDCs—just over 10 per 100 inhabitants by the end of 2015[b]—achieving "universal" coverage would imply a required growth rate of 51 percent a year, much faster than the LDCs have achieved since 2000. Affordability is also likely to be a challenge as only 1 of the 48 LDCs, Bhutan, actually met the UN target in 2013.[c] Nevertheless, LDC mobile coverage currently stands at close to 70 subscriptions per 100 inhabitants. As those mobile phones are upgraded to smartphones, and as coverage of 3G (third-generation) and 4G (fourth-generation) signal expands, this target will become more attainable—although perhaps not by 2020.

The real significance of the internet for the SDGs is likely to lie in helping to achieve other targets, such as target 3.9 on achieving universal health coverage, target 5b on promoting women's empowerment, or target 10c on reducing the transmission costs of migrant remittances to below 3 percent.[d] As noted, timely, fine-grained information on households, the economy, and the environment can accelerate achievement of the SDGs. This information can provide actionable feedback on where and why progress is or is not being made. This is the essence of the "data revolution," called for by the High-Level Panel of Eminent Persons in their 2013 report, which kick-started discussion of the post-2015 development agenda.[e]

a. See http://www.un.org/millenniumgoals/.
b. See ITU 2015.
c. The target for affordability, as defined by the UN Broadband Commission, is a monthly price for entry-level broadband below 5 percent of gross national income (GNI) per capita: see http://www.internetsociety.org/map/global-internet-report/?gclid=CLv0tI35yMYCFQ2QHwodcWYGaw#affordability-mobile-broadband.
d. See UN 2014.
e. See UN 2013.

Box 6.5 Digital Green: "How-to" videos for agriculture and health

Digital Green uses video cameras, battery-operated projectors, and the internet to get information into the hands of villagers in India and Africa. It works like this: Local people film local farmers demonstrating a useful agricultural technique or health practice. These include preparation of seeds, enhancements of milk yield in cattle, and oral rehydration therapy for children suffering from diarrhea. The videos are pooled on the internet. Then local resource people download, show, and explain seasonally appropriate videos to community assemblies. The premise is that the home-grown videos convey the technical details of the technique, and do it with the credibility of a neighbor speaking in a familiar dialect.

The system automatically keeps track of which videos are most likely to prompt adoption, so monitoring is an integral element of operations, not a burdensome add-on. An early self-evaluation reported a 90-percent reduction in the cost per adoption. A randomized controlled trial found that 16 percent of farmers exposed to Digital Green adopted a yield-increasing, water-conserving rice cultivation system, versus 10 percent in a control group. The program, in operation since 2008, reached 660,000 people in 7,645 villages by April 2015.

Sources: http://www.digitalgreen.org; Gandhi and others 2009; Vasilaky and others 2015.

mixed results.[34] A program that sent voice advice to farmers was little used and had no impact. Another, targeted at cotton farmers, shifted them to less harmful pesticides and more valuable crops. A program that put smartphone-equipped extension agents in contact with experts improved farmer awareness of extension services, but the impact on incomes was not measured. In Peru, however, a careful experiment showed that provision of market information via cellphones boosted farmers' selling prices by 13 percent and increased the participation of subsistence farmers in the markets.[35] The effects were particularly marked for perishable goods and for risk-averse farmers. A particularly interesting program—because its "how-to" video approach could be applied in domains outside agriculture—is Digital Green (box 6.5).

More ambitiously, a movement toward "precision agriculture" crunches big data to provide farming advice. At its most capital-intensive, an instrumented tractor gathers georeferenced data on field conditions and plant health. These data are combined with weather data and fed into a computer model of plant growth. The model then works through the tractor, fine-tuning the application of fertilizer and pesticide as it traverses the field. By curbing overuse of fertilizer, water, and pesticides, precision agriculture can improve the environment while boosting farm profits.

More affordable approaches are needed for the developing world. An emergent example is a system of decision support for rice agriculture in Colombia developed by the national rice association with support from the International Center for Tropical Research. Colombian rice yields have been falling as increased climate variability invalidates traditional calendar-based rules of thumb on when to plant. The decision-support system merged historical data on climate and harvests with current weather forecasts to advise farmers on optimal planting decisions. In an early application, the model correctly foresaw that crops would fail due to drought and advised farmers not to waste time and money on planting.

Donor funds (including NGO funds) and technical inputs have been important in most of these initiatives. Many fail to scale up. All face the challenge of finding a sustainable business model. This may entail a combination of subscription sales and recurrent public financing. Assessment of the benefits of this information could help in pricing decisions and in determining the role of public finance.

Information as an input to managing complex systems

Much of development involves managing complex systems, such as power networks and urban transportation. With better information and analysis, these systems can be designed and managed for greater efficiency.

Power utilities can be helped by information in a variety of ways (see sector focus 5, "Energy"). Developing countries, though short on power, nonetheless see much of their electricity production lost to poor

maintenance and to theft. Data analytics can optimize schedules for transformer maintenance and replacement, and can pinpoint locations for attention to reduce theft. Big data can also be used to enable grids to assimilate the ebb and flow of power from wind turbines and solar panels, and to adjust prices in real time to shave off peaks in demand. Put together, these tweaks in system operation can reduce power outages, reduce the need to invest in expensive peak supply, improve the bankability of power, and reduce environmental damages. Many of the same principles can be applied to water utilities.

Urban transport is another complex system where newly cheap information unlocks possibilities for greater efficiency. A good starting point is with the most basic foundation of planning: of the 25 largest low- and lower-middle-income cities, 92 percent do not have complete maps of their transit networks.[36] Compiling these maps used to be time-consuming and expensive. Recently, though, Manila developed and applied a mobile phone–based application to survey and map routes, using an open-source data standard. The map powers a consumer trip-planning app and is being used by city planners to reduce redundant routes and plan a new mass transit corridor. In Seoul, the transit agency used locational data from 3 billion nighttime phone messages to map travel patterns and design an optimal route for the immense city's first late-night bus service. Traditional household surveys would have been slower, more expensive, and less informative. Moving on from static mapping, an initiative in Cebu, the Philippines, was able to ingest real-time taxi data to generate speed and congestion maps for the entire city. This reduced the time to analyze travel time for a bus corridor from two weeks to two seconds. Ultimately cities may be able to use real-time data to design and implement policies that increase transit accessibility, decrease travel time, substitute for expensive road construction, and abate congestion and pollution.

Rural land management, to be efficient, depends on accurate and accessible information about land plots. Land sales and rural credit markets function better when there is a comprehensive system of land registration. Secure, registered land tenure also gives farmers incentives to invest in their land and protects them from illegal expropriation. ICTs have revolutionized the logistic burden of mapping, recording, and verifying landholdings—key elements of documenting land tenure. They do so in two ways. First, mapping boundaries with GPS is much faster, less expensive, and less demanding of scarce skills than traditional surveying. Second, open and transparent digital registration of land titles reduces the cost of verifying ownership and inhibits fraud and corruption. Thus land registration is a platform for building a variety of valuable services.

As an example of the potential, a pilot land regularization project in Rwanda used aerial photography and digital registration, and was found to double the rate of investment and maintenance of soil conservation structures.[37] The effect was particularly marked for female-headed households. But the gender impacts were complicated because of the way tenure regularization interacted with laws and traditions. Married women improved their land access, but those in informal unions were worse off. Girls' and boys' planned land inheritance was equally boosted—except in female-headed households, where sons gained an edge. Contrary to expectations, there was no effect on access to credit. Overall, the pilot was sufficiently successful that it is being expanded nationwide, to 10 million land parcels, at a cost of US$5 a parcel.

Environmental management also depends on land data. Since the 1970s, Brazil has used satellites to monitor deforestation in the Amazon. In 2003 the government made a landmark decision to release the raw data. This enabled NGOs such as IMAZON to develop their own analyses, improving the information base and raising public awareness and pressure for environmental action. Starting in 2004, the Brazilian government began using monthly data to guide enforcement of forest and agricultural policy, with demonstrable impacts on reducing deforestation.[38] More recently, Brazil embarked on an ambitious program to precisely map every rural property and use satellite observations to monitor compliance with forest conservation regulations. By September 2015, it had registered 2.1 million properties covering 2.6 million square kilometers.[39] Registry in this environmental cadastre is a condition for credit and other services, motivating compliance. It also sets up a framework for trading forest conservation obligations, which reduces the cost and increases the benefits of conservation.

Disaster risk management inherently demands a great deal of timely and location-specific information. Over just the past few years, internet-enabled information has begun to change the way in which donors respond to emergencies, and is helping to increase disaster preparedness and resilience (box 6.6).

For all these systems' management challenges, big data offers plausible efficiency gains. In many cases, realizing those gains involves overcoming not just technical obstacles, but also political ones.

Box 6.6 Disaster risk management

As climate becomes more volatile and populations swell in coastal, floodplain, and earthquake-prone areas, disaster risk management (DRM) becomes ever more important. Annual disaster losses now average US$200 billion globally, and large disasters can derail a country's growth. Information and communication technology (ICT) applications—especially those involving crowdsourced, open data and open-source software—are rapidly being incorporated in each aspect of DRM:

Risk identification and mitigation. The best way to deal with disasters is to build resilience in advance, so that when the storm or flood or earthquake hits, lives are not lost and damage to property is minimized. This requires extensive, geographically precise information and planning. What locations are subject to natural disasters, with what probability? How sturdy are the buildings in those locations, and who occupies them? Which ones need to be shored up and how much will that cost? Detailed answers have typically not been available. Map data have been inadequate, often inaccessible, and difficult to handle. But with revolutions in geographic information systems, remote sensing, and crowdsourcing, that is changing.

In flood-prone Jakarta, Indonesia, for instance, the Disaster Management Agency asked the heads of the city's 267 wards to map the location of critical infrastructure using OpenStreetMaps, a tool that allows volunteers to create detailed digital maps that can be used without restriction. More than 1 million buildings have been mapped. InaSAFE, an open-source software program, was then used to analyze potential impacts of floods, and helped in the response to the 2013 and 2014 floods. More recently, petajakarta.org exploited the city's high rate of Twitter usage to crowd-map flood locations in real time during the 2014–15 monsoon season, helping citizens navigate the flooded city and augmenting the DRM agency's information base.

Early warning. Many lives have been lost for lack of adequate warning of impending disaster. Now, widespread access to mobile phones, combined with weather monitoring systems, allows for timely and near-universal warnings. For instance, the Philippines's Project NOAH (Nationwide Operational Assessment of Hazards) uses real-time data from rain gauges, water sensors, and radar to provide evacuation alarms.

Damage assessment and response. In the chaos following a disaster, it has been difficult to match relief supplies with need, and then to inventory damage and prioritize recovery operations. Here again, crowdsourcing has revolutionized response. After the devastating 2010 Haiti earthquake, a spontaneous volunteer effort used the Ushahidi platform to aggregate and map status reports and requests for help from social media and text messages. Over 1,000 Haitian volunteers living abroad translated and geolocated the messages. And more than 700 volunteers used OpenStreetMaps to create new maps. These were subsequently updated, by more volunteers, with satellite and aerial imagery, to form the basis for the postdisaster needs assessment. Technological progress continues: after Vanuatu's 2015 cyclone, drones were used to survey damage, providing much more detailed damage information than is possible with aerial photography.

The move of these methods to open-source software and open data is noteworthy, and has implications beyond DRM. For capacity- and cash-constrained agencies in developing countries, open-source software is much cheaper to acquire than proprietary software, and avoids dependency on a single supplier. It allows high levels of customization and, because it often adheres to open standards, easier integration with other software. It encourages cross-fertilization, community building, and code sharing with others around the world; for an example, see geonode.org. These advantages need to be weighed against the potentially (but not necessarily) higher level of support offered by proprietary software.

Similar considerations apply to open data. By opening data, it is easier to find and assemble the multiple layers of information—land cover, topography, population, infrastructure, hydrology—necessary for DRM. And, of course, open data can be distributed to users free of charge.

Crowdsourced data are not without difficulties. Accuracy and completeness are issues. Both Haiti and Jakarta developed systems for confirming the accuracy of reports. Sustainability of volunteer engagement is a challenge, since DRM data need constant updating. Feeding back the information to communities is one way to encourage this.

Of course, crowds are just one data source. A key to DRM is the integration of many different kinds of information. Rio de Janeiro's Center of Operations prepares the city to deal with its many risks, including floods and landslides, by combining real-time information on rain, tides, transport, and city services with 560 video cameras. It also serves to coordinate the diverse government departments, and to feed information to the public and the media.

Sources: WDR 2016 team based on inputs from the Global Facility for Disaster Reduction and Recovery; Haklay and others 2014; Heinzelman and Waters 2010; Holderness and Turpin 2014; Matheus and Ribeiro 2014.

Powerful interest groups may stand to lose from systems efficiency. These include consumers and utility employees who benefit from electricity theft, operators of unregulated minibuses, land-grabbers, and flouters of environmental regulations. Disaster risk management and climate adaptation require extensive coordination among ministries used to working independently. Donors may be able to play a role in supporting the complementary reforms necessary to overcome these obstacles.

Information as an input to poverty reduction efforts

In fighting poverty, as in any strategic endeavor, it is useful to diagnose challenges and track progress. Timely, disaggregated poverty indicators could promote accountability, boost motivation, and provide the kind of relevant feedback described earlier in this chapter, at the policy level. For instance, many proposed policy reforms have potentially large and poorly understood distributional impacts, sometimes leading to contentious gridlock. The ability to predict those impacts and then to verify them in practice could help to accelerate reforms. Up-to-date information on the location, health status, and consumption patterns of poor people could help design and target programs more efficiently. For these reasons, a panel commissioned by the United Nations[40] sees better data as an indispensable tool for achieving the Sustainable Development Goals (SDGs) (see spotlight 5, "The data revolution").

To date, however, development decisions and priorities have often been made while flying blind. For instance, energy subsidy reform—a trillion-dollar-a-year issue with huge poverty and environmental implications—is contentious in many countries. Yet an authoritative global analysis of the poverty impacts of reform was forced to use household data that were, on average, more than eight years old.[41] Consider this sobering picture of the state of knowledge about African growth and poverty.[42] Just half of African countries compute GDP using current standards; when Ghana adopted those standards, national income was found to be nearly two-thirds higher than previously thought. Only one-third of countries have two comparable measures of poverty over time, and even then the latest estimate is often years out of date. To make things worse, basic civil registration systems cover only 45 percent of births in Sub-Saharan Africa, making it difficult to track child mortality (one of the starkest measures of poverty) or to get an accurate measure of population. Thus it is difficult to track progress even at the national level, let alone at the fine-grained level relevant to provinces or communities.

However, many countries lack the money to fund basic information systems, the organizational incentives to share information, and the human skills to supply and use data. International actors can help on all counts. Donors have supported keystone household surveys, including the Living Standards Measurement Surveys and the Demographic and Health Surveys. These have provided crucial information for decision making, with the added benefit of facilitating international comparisons, thanks to standardized definitions. Donors have also supported capacity building at national statistical organizations. But as noted, coverage is far from complete and timely. A comprehensive program of statistical gap-filling for the 77 low-income countries that belong to the World Bank's International Development Association (IDA) is estimated to cost about US$1 billion a year.[43] Current official development assistance runs around US$350 million, according to the report, while domestic spending is not known.

Costs may be reduced, or effectiveness improved, through new technologies. For instance, computer-aided surveying can reduce the cost of traditional household surveys by 60 percent.[44] New opportunities are arising to complement traditional censuses and surveys with big data that can provide up-to-date information at a fine geographical level. For instance, cellphone call detail records are being used to impute real-time measures of poverty—and internet data, to construct real-time inflation or even GDP measures. These techniques are not likely to replace traditional statistical sources. Quite the contrary: high-quality censuses and surveys become even more valuable because they can adjust for biases in big data (see box 6.7).

Mustering information for global public goods

Many problems—climate change, ozone depletion, air pollution, epidemics, financial crises—are features of globally interconnected environmental, economic, and social systems. Addressing them requires coordinated global actions. Setting priorities and targeting actions require global information. That information is itself a global public good. As such, it is subject to the scale effects described earlier in this Report.

Perhaps the quintessential example is the immensely valuable data on weather, water flows, and climate. One estimate of the benefits of upgrading developing country weather systems to developed country standards is between US$4 billion

Box 6.7 Can "big data" provide real-time, geographically detailed information on poverty?

Traditional surveys and newfangled big data sources have complementary strengths and weaknesses. Surveys work very hard at being accurate—for instance, precisely tallying the value of everything a household buys or produces—and making sure that everyone in the target population, especially poor people, are covered. This makes it possible to accurately measure changes over time. But even with tablet-assisted surveying, traditional household survey data will be months old before they are published. And sample sizes of a few thousand do not allow much insight into what is happening with subgroups or at particular locations.

So researchers are trying to estimate income with cellphone use data, which cover a large proportion of the population, are literally up to the minute, and can provide a snapshot of activity at the level of a village or urban ward. The estimates use information such as how often the user buys airtime, in what denominations, and the frequency of international calls. Hurdles include finding ways to ensure data anonymity and convincing phone companies to share data. But the big disadvantage, from a monitoring perspective, is that the data do not accurately represent the population. Many poor people do not have phones. And the relationship between income and airtime purchases will change over time as prices of service and phones change.

One possible solution is to use repeated small "gold standard" surveys to calibrate the cellphone data. A hint of the possibilities is given by a study that successfully replicated the results of a populationwide opinion poll based on a survey of Xbox gamers—a predominantly young, male group. The key was a sophisticated method of correcting for the skewed nature of the sample using information on the age and sex distribution of the general population.[a]

a. Wang and others, forthcoming.

and US$36 billion a year.[45] Data on river flows are essential for disaster risk planning and for planning and operating hydropower and irrigation systems. And detailed long-term data are essential for tracking and understanding climate change patterns. These data are sorely underprovided. Because weather is a global system, every observation of temperature and precipitation improves weather forecasts (and climate models) at the transnational and even global levels. But poor countries do not have a dense enough network of observation stations even for their own purposes, let alone to contribute to the global good (see map 6.2). Another 4,000 to 5,000 stations are needed in Africa alone.[46] Part of the problem is a lack of funds and capacity to build and maintain stations. Another is that many state-run hydrometeorological agencies refrain from the free distribution of globally valuable data to garner modest revenues from selling data points, not just in poor African countries but also in the majority of European countries.[47]

Once again, technology is making it easier to gather and analyze data of global significance. For instance, tropical deforestation is a global concern, a major source of carbon emissions and biodiversity loss and an issue related in complex ways to rural poverty. Yet until recently, data on tropical deforestation were spotty, inconsistent among countries, and woefully outdated. Now, Global Forest Watch publishes monthly deforestation maps that can spot clearings of as little as 25 hectares.[48] On the horizon are satellite data that might enable daily monitoring at a level well below a hectare. Similar advances are being made in transboundary air pollution (see sector focus 6, "Environmental management") and surveillance of emergent zoonotic diseases.

So there is a role for global finance in the supply of this kind of information, but that is only the beginning. There is a need also to build the willingness to share information, and the capacity to use it.

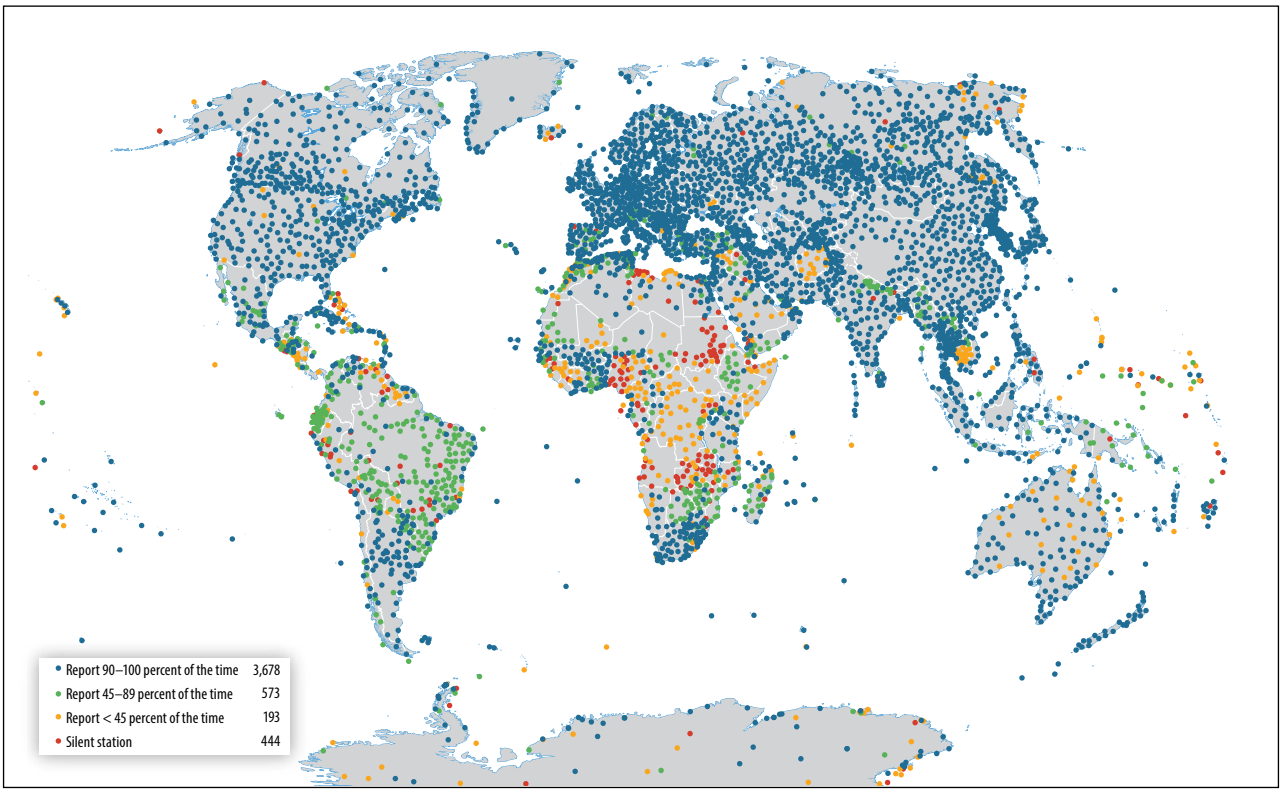
The future of global development cooperation

What's the role of development agents and international organizations in a world where their financial heft is miniscule? The answer set forth here is threefold: in concentrated efforts in the poorest countries; in catalytic injections of ideas, backed with cash, everywhere; and in spearheading global collective action. The data and technology revolutions are arriving in time to bridge the gap between resources and ambition by amplifying the impacts of action and including more people in the formulation and execution of plans. But for this to work, development agents must tackle policy constraints, internal and external.

Start with the *how* of development operations. With new technologies, development agencies can

Map 6.2 Availability of reports from weather stations

Proportion of time that weather stations report SYNOP (surface synoptic observations) data to the World Meteorological Organization



Source: World Meteorological Organization SYNOP data for October 2013, https://www.wmo.int/pages/prog/www/ois/monitor/index_en.html.

IBRD 42013

be more inclusive by tapping the wisdom of beneficiaries in designing interventions. They can crank up their efficiency by using rapid feedback to refine and improve their actions through trial and error, and use open-source evaluation to align performance management with learning. But these approaches will not come easily in organizations that emphasize spending and outputs over results, have burdensome structures for accountability, and see any failures as damning rather than informative. If traditional agencies cannot adapt, some of their business may be taken up by disruptive newcomers, such as GlobalGiving, GiveDirectly, or development impact bonds (box 6.8).

Next, the *what*. Previous chapters have pointed to many areas where external agencies could catalyze development—for instance, in supporting policy reforms that would open up internet access or new approaches to service delivery in health. In this chapter, the emphasis is on creating information services that help individuals and systems managers make better decisions in ways that promote poverty reduction. These services have fixed setup costs in software and data assembly, but can have near zero costs for distributing information. So the private sector will tend either to shy away from providing these services, or to price them at a level that shuts out poor people who could benefit.

Donors can provide the funds and expertise to help get these services going. They can, for instance, support the assembly of critical data and the creation of broadly applicable open-source software. There is a real need, however, for coordination. A DFID study found 70 unrelated mobile-for-health pilots in Uganda, and over 1,800 mobile apps worldwide.[49]

There's another reason for development agents to get involved: to help address the policy issues that impede innovation, or to support complementary investments or capacity building. Thus, for instance, making progress on urban transit could require a combination of information systems, investments in infrastructure, and investments that address opposition to regulation of minibuses or reduction in on-street parking.

Box 6.8 Disruptive approaches to development

Some radical reimaginings of development assistance involve digital technologies to eliminate some of the overhead costs and procedures of traditional approaches. GiveDirectly uses satellite imagery, crowdsourced assistance, and machine learning to identify poor villages in Kenya.[a] The trick: using thatched roofs as an indicator of poverty. Staff are dispatched to the villages to enroll the residents of the thatched houses. GiveDirectly then sends US$300, by mobile phone, to the enrollees. Overhead costs are just 8 percent (for staff and the cost of foreign exchange and money transfers). A randomized controlled trial found a 42-percent reduction in the number of days children go without food, a 58-percent increase in assets, and a 38-percent increase in revenue from self-employment.[b]

GlobalGiving's internet platform allows nongovernmental organizations (NGOs) to post development project proposals for funding by donors, large and small. Thus it taps a more grassroots field of ideas and implementers than traditional agencies. Its website keeps track of project performance and NGO credibility (such as whether NGOs regularly report audits), feeding this information back to donors. GlobalGiving uses its platform to provide online capacity building to the grantees, and allows them to build a reputation based on performance and investments in learning. It plans to assist the grantees in tracking their results, ultimately fostering benchmarking and mutual learning.

GiveDirectly and GlobalGiving thus sidestep much of the traditional costly apparatus for project selection, appraisal, and supervision. GiveDirectly achieves these efficiencies by focusing on a logistically simple intervention. This cannot substitute for interventions that involve externalities or require collective action or large investments. But it implicitly challenges interventions that have more "moving parts"—can they achieve equal impact at equal cost? Global-Giving achieves efficiencies by pushing project appraisal, quality assurance, financial controls, and safeguards to the funders and to the wisdom of crowds, informed by a growing stream of data. Time will tell whether these are inherently niche operations, or the pioneers of a new way of doing development business.

a. Abelson, Varshney, and Sun 2014.
b. Haushofer and Shapiro 2013.

Finally, external agents and international organizations can encourage the unlocking of existing data. Open data can be a powerful tool (see the discussion of open data in the context of disaster risk management in box 6.6). But too often, socially beneficial data are kept under wraps. Both the public and private sector are culprits. As noted, this is true of government-collected data on weather and river flows. In some transboundary river basins, upstream countries do not share river flow data with downstream neighbors, crimping flood preparedness and irrigation management. Basic data on poverty also suffer. Among the Sub-Saharan household surveys that underpin poverty estimates and give insight into causes and correlates of income, education, and health outcomes, fewer than half are available online and free of charge.[50] For East Asia and the Pacific, the proportion is less than 20 percent. Private telecom companies closely hold, and use for commercial purposes, data on cellphone calling patterns useful for transport planning and poverty analysis.

Donors and development agencies can catalyze the potential for open data in several ways. They could work with partners to expand the availability of open data. The principle would be that all supported activities should generate open data by default, with exceptions on the grounds of privacy and other defined concerns. So, support for health and education systems should ensure that these systems track and disclose performance data to the extent possible, while preserving confidentiality of individual records. This also holds for public-private partnerships (PPP), many of which currently do not furnish any data about their performance, and which may use client-generated data for commercial gain. Agencies that advise on or finance concessions in power, water, transit, telecom, and other services could demonstrate to public authorities the advantages of making performance data open. Data could include public scrutiny of the concessionaire, informative new data "mash-ups," and the capacity for open-source evaluation of options for improved equity and efficiency. Agencies could then help governments craft PPP contracts that recognize the rights of clients to their own information and of the public to anonymized performance data. Donors, both traditional

and nontraditional, can set a good example by ensuring that their own data are open—particularly, meteorological and hydrological data with transboundary benefits. They can support policy reforms in developing countries that fund data-producing agencies, allowing them to reduce fees.

Agencies or international organizations could also explore the potential to create sectoral data standards. Open data are more useful when they can be consistently compared and aggregated across units. Data standards also make it easier to develop apps and programs for use and analysis. The Group on Earth Observations, an international consortium, is doing this for remote sensing data. Development agencies could work together to create standards for data on development impact or results. A beginning would be to more thoroughly report results under the International Aid Transparency Initiative standards. Some agencies report financial transactions, but only 5 out of 68 agencies publish machine-readable information on project targets and results—which would allow benchmarking and comparison across providers.[51]

Finally, as noted, there are significant financing needs for building the data that could guide the pursuit of the SDGs, and the capacity to use those data. There could be opportunities to build reusable, customizable open-source software and systems for monitoring the SDGs, reducing duplication of efforts, saving costs—and improving lives.

Notes

1. David Clark's often-quoted statement refers to the work of the Internet Engineering Task Force (IETF). See https://www.ietf.org/tao.html.
2. Wu 2010.
3. World Summit on the Information Society 2005.
4. Much of the discussion in this section is derived from Dutton (2015) for this Report.
5. Sadowsky 2014, 82; UNESCO 2015.
6. Portions of this section are adapted from Satola and Kelly (2014).
7. See http://www.itu.int/wsis/index.html.
8. Dutton 2015 for this Report.
9. Dutton 2015 for this Report.
10. See, for example, Judy and Satola (2014).
11. In May 2011, UN Human Rights Council Special Rapporteur Frank La Rue issued his report on the right to freedom of expression on the internet, saying that states are increasingly censoring information online through arbitrary blocking or filtering of content, criminalizing legitimate expression, imposing intermediary liability, disconnecting users from the internet, and not providing adequate protections to privacy and data. See http://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27_en.pdf.

    The UN Human Rights Council issued a second report in April 2013 suggesting that nations' laws on surveillance were overbearing and recommending that states revise and align their surveillance laws to comply with international human rights. See http://www.ohchr.org/Documents/HRBodies/HRCouncil/RegularSession/Session23/A.HRC.23.40_EN.pdf.

    In June 2012, the UN Human Rights Council adopted a resolution preserving human rights on the internet, affirming that people have the same rights online that they have offline—in particular, freedom of expression (A/HRC/20/L.13) (June 29, 2012).
12. The WCIT Final Acts are available at http://www.itu.int/en/wcit-12/Pages/default.aspx. For an analysis of the outcome, see http://www.cullen-international.com/asset/?location=/content/assets/regulatory-intelligence/regulatory-news/wcit-12_post-mortem_culleninternational.pdf/wcit-12_post-mortem_culleninternational.pdf.
13. IANA, a subsidiary of ICANN, has traditionally performed certain technical functions essential for the smooth and secure running of the internet, including control of the internet protocol (IP) addressing system (numbering resources, including IPv4 and IPv6), managing IP protocols, and managing the root zone database for domain names (domain name management). The U.S. government, through the National Telecommunications and Information Administration (NTIA), a branch of the U.S. Department of Commerce, has had oversight over these functions through a series of agreements with ICANN, first formalized in 1998 under what was called a memorandum of understanding. The memorandum went through several iterations and morphed into what was then called the Joint Project Agreement, which itself underwent one amendment. In 2009, it was replaced by a document called the Affirmation of Commitments. In each iteration of the agreement between NTIA and ICANN, and over time, NTIA has "loosened" its oversight of the performance of these IANA functions by ICANN. This latest move by NTIA can be seen as part of a continuing evolution away from NTIA's control and oversight of IANA functions.
14. In August 2015, NTIA announced it would defer the deadline for considering a transition proposal for at least a year.
15. In addition to endorsement of the MSM by the UN's World Summit on the Information Society, both the Organisation for Economic Co-operation and Development and the European Commission have reconfirmed their support. See European Commission (EC 2014) and OECD (2014b).
16. See European Commission (EC 2014).
17. It is important to note that the sale of music files does not necessarily take place across borders. In

many cases, the sale of digital goods across borders is blocked by geographically limited IP regimes. This applies to other digital goods like e-books and videos. Instead, one should think about these cross-border transactions as transactions between firms in different countries for the license to sell the content. See Nicholson and Noonan (2014) for a discussion.

18. Mandel 2013.
19. Bauer and others 2014.
20. Bauer and others (2014) calculate the percentage changes to GDP, investment, and total exports as a result of the proposed legislation in a Global Trade Analysis Project (GTAP) model. The effects of the data regulations are included in the model as an increase in business costs, an increase in costs for data-driven services trade, a decrease in investments, and a decrease in the effectiveness of data-related research and development.
21. National Board of Trade 2015.
22. For example, in October 2015, the European Court of Justice declared invalid the EU-U.S. "safe harbor" rules regulating internet firms' retention of Europeans' data in the United States. An ongoing case between Microsoft and the U.S. Department of Justice seeks to clarify whether U.S. government agencies can access e-mail messages stored in Microsoft servers in Europe.
23. For example, the EU's Binding Corporate Rules (BCRs) require firms to set up internal company policies and appoint personnel to handle cross-border data transfers. These firms must go through a certification process overseen by a data protection office, which involves audits and company visits. As of May 2015, only 66 companies had obtained BCRs, and most of them are large multinational companies.
24. IATA 2015.
25. A study by Aguiar and Martens (2013) finds that illegal music downloads do not displace legal music sales. The individuals in the study would not have purchased the music they downloaded illegally if it was not available on the illegal downloading website.
26. van Pottelsberghe de la Potterie and Mejer 2010.
27. See Easterly 2006, 2014; Andrews, Pritchett, and Woolcock 2013; Ramalingam 2013; Whittle 2013; Booth and Unsworth 2014.
28. Andrews, Pritchett, and Woolcock 2013; Whittle 2013.
29. The correlation shown in figure 6.8 could potentially have a spurious component, if the ex post M&E rating influences the outcome rating. However, the correlation holds when the independent M&E rating is related to the self-rating of outcome. Moreover, a review of 195 in-depth project evaluations looked at positive and negative mentions of the specific roles of problem-solving, frequency of supervisory visits, and M&E design quality. It found them to be highly associated, in magnitude and statistical significance, with better and worse project outcomes.
30. OECD 2014a.
31. IEG 2011.
32. OECD 2014a, 22.
33. Lobell, Cassman, and Field 2009.
34. Nakasone, Torero, and Minten 2014.
35. Nakasone 2013.
36. World Bank 2015.
37. Ali, Deininger, and Goldstein 2014.
38. Assunção, Gandour, and Rocha 2013; Assunção and others 2013.
39. Government of Brazil 2015.
40. See UN 2013.
41. del Granado, Coady, and Gillingham 2012.
42. Devarajan 2013.
43. Espey 2015.
44. Espey 2015.
45. Hallegatte 2012.
46. Rogers and Tsirkunov 2013.
47. Rogers and Tsirkunov 2013.
48. See http://www.globalforestwatch.org.
49. Ranger, Chandler, and Arscott 2015.
50. Demombynes and Sandefur 2014.
51. Aid Transparency Index 2014. http://ati.publishwhatyoufund.org/findingapproaches-to-publishing-results-information/.

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