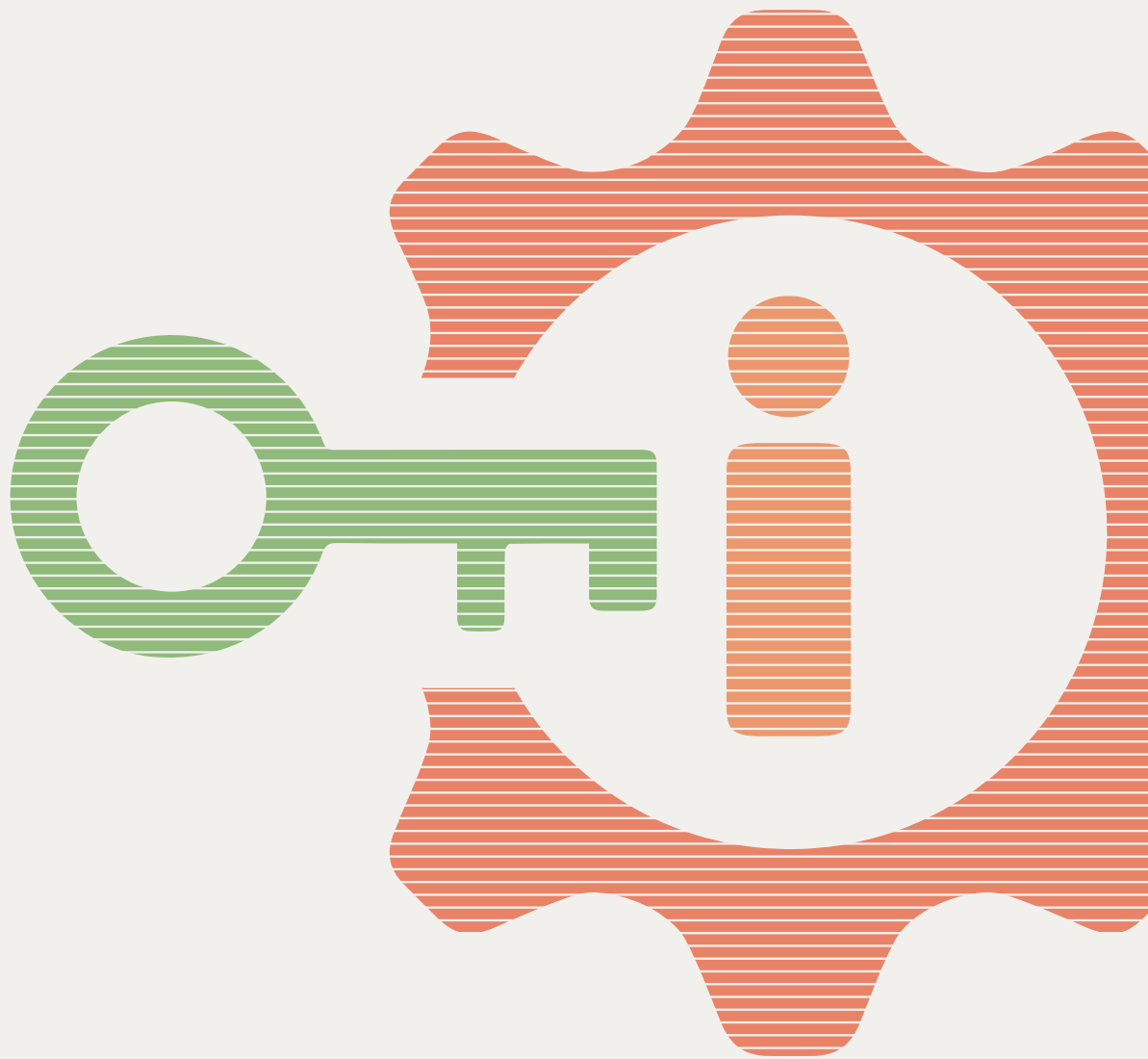




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The International Federation of Library Associations and Institutions (IFLA) is the leading international body representing the interests of library and information services and their users. It is the global voice of the library and information profession.

The Technology & Social Change Group (TASCHA) at the University of Washington Information School explores the design, use, and effects of information and communication technologies in communities facing social and economic challenges. With experience in over 50 countries, TASCHA brings together a multidisciplinary network of researchers, practitioners, and policy experts to advance knowledge, create public resources, and improve policy and program design.

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Chapter 6:

A2I for Sustainable Infrastructure

Access to information as a fundamental pillar for innovation, infrastructure, and industrialization

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Information is critical for ensuring healthy, sustainable and economically vibrant societies. It is an intangible good used by people, and increasingly by machines, to develop services and enhance knowledge and expertise, and is deeply woven into the fabric of sustainable development. This is true for all the United Nations Sustainable Development Goals (SDGs) including Goal 9, which focuses on building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation.

Information is a unique type of resource. Unlike other resources that need renewal or diminish with use, the value of information increases with its consumption; the more widely it is shared, the greater its impact and the more extensive its potential benefits. This is the premise that underlies the many different, but related “open” movements now sweeping across the globe. Open government, open data, open science and open access are all parallel efforts that aim to make information and data more available in order to maximize its use and value.

In the case of open government, for instance, the huge volumes of information produced by governments are considered to be key resources for social and commercial activities. Providing citizens with access to government information not only ensures greater accountability and improved public engagement with governmental activities, it also contributes to a wide array of economic outcomes, allowing businesses to use the information to develop novel services. The GovLab, a research center based at New York University that studies the impact of government information, asserts that access to government information stimulates economic growth, opens up new sectors, and fosters



Open data stimulates economic growth, opens up new sectors, fosters innovation, and so creates jobs and improves lives.

innovation; in the process, this creates new jobs and new ways for citizens to prosper in the world (Verhulst & Young, 2016).

There are numerous examples of the use of government information and data by businesses around the world. The whole weather forecasting industry, for instance, is built on openly available environmental data. Similarly, access to geospatial information has stimulated the development of a huge array of applications, such as the Canadian “Neighbourhood Finder” initiative, which helps people find the ideal neighborhood for their lifestyle, allowing users to choose from more than 50 criteria (house pricing, school quality, commute type, proximity of amenities, safety, etc.) and finding the five neighborhoods that match best in Canadian cities (Neighbourhood Finder, 2015). Each year, the GovLab publishes a list of companies in several countries that use federal government open data. The list contains 17 categories of businesses, such as health care, education, environment, energy, finance, and transportation, reflecting the wide variety of services that are using open government data (Open Data 500).

6.1 Exploiting the open content of the web

It is estimated that the volume of information and data doubles every two years (Marr, 2015). Data is generated by everything around us at all times; every digital process, sensor and mobile device, and social media exchange produces data (IBM, 2016). The exploitation of this so-called “big data” has become a huge driver of economic performance. Through a variety of techniques such as data analytics and text mining, large volumes of raw content drawn from thousands of documents and data are converted into structured overviews, helping to discover patterns and extract new knowledge. We already encounter this in numerous aspects of our daily lives. Take the now ubiquitous recommender systems attached to many online services. While not always completely on target (e.g. “I’ve just been to Barcelona, so stop showing me advertisements for hotels there!”), they are becoming more sophisticated. Recommender systems are built on data collected from different sources and use inference methods to identify related content that might be of interest to users. Good recommender systems, along with access to data, have become a necessity for the competitive advantage of many online businesses; so much so that Netflix even offered a \$1 million prize for anyone who could help improve its recommendations by 10 percent (Netflix, 2009).

Likewise, we are also seeing the rise of content aggregation platforms that pull together and repackage content created elsewhere. Storify and Pinterest, for example, are both built on this model. But it’s not just big tech companies that are doing this; small businesses can also leverage the open content of the web for new business opportunities. The U.S.-based startup company Edamam, for example, text mines web resources and has developed an extensive knowledge base about food and nutrition for its customers. There are millions of recipes on the web, and they are increasingly accompanied by nutritional data. Edamam uses digital technologies to extract information from these highly distributed resources and generates real-time nutritional analysis for its users. By also leveraging government nutrition information, the Edamam platform categorizes information by different attributes, such as nutrition information, allergies, cooking time, recipe complexity and so on, helping users make healthier food choices (Edamam mines web data, 2017). While it is hard to estimate the impact of big data on economic performance, the European Commission (and many countries) considers big data a key contributor to competitiveness, growth and jobs in the 21st century (European Commission, 2017).

High-quality, publicly available information can also be a significant factor in the success of small businesses and self-employed people, helping them to innovate and adopt more efficient practices. In 2006, the British Library opened a Business and IP Centre in London to provide specialized support for small businesses. The

center offers users access to a comprehensive collection of databases and publications, plus a program of practical workshops, one-on-one advice sessions and inspiring talks. The center has been extraordinarily successful. Over the past decade, more than 500,000 people have used the service, including more than 60,000 visitors in 2016 (British Library 2016). Many other libraries are following suit, recognizing the potential advantages for small businesses in having access to information (British Library, 2016).



The Human Genome Project aimed for **openness**, with sequencing **data** released within 24 hours. It succeeded in its objective two years early.

6.2 Everyone stands to benefit from access to information

Agriculture, a huge and important sector in most economies, is also being revolutionized because of access to real-time data and information. A large number of farmers are subsistence farmers, with an estimated 2.5 billion people around the world managing 500 million smallholder farm households (Smallholders, Food Security and the Environment, 2013). According to the United Nations, small farming is poised to unleash a new and sustainable agricultural revolution that could profoundly improve the lives of billions of people, if we can enable the right conditions (Smallholders, Food Security and the Environment, 2013). Critical to this revolution is improving farmers’ access to information. Indeed, information has been characterized as “the cornerstone to successful farming in the 21st century” (Weiss et al, 2000).

Farmers’ information needs are wide-ranging and include up-to-date information about weather and market conditions, research on new farming techniques, transportation schedules, and knowledge of fertilizers and pest controls. The Plantwise Knowledge Bank is one of many platforms being developed to link farmers with the information they need. For example, the Knowledge Bank has developed a search tool that helps farmers identify pests. Funded and supported by governments around the world, the tool enables farmers to identify new pests, infestations and diseases based on their geographic location, crop, and the plant part that has been affected. The technology has now been adapted for use on smartphones, allowing a much larger number of small farmers to use it (Plantwise Knowledge Bank, 2017). As more applicable information and data become available, the next challenge will be to connect farmers to the information in a way that it can be most usefully exploited.

6.3 Opening science for innovation: The Human Genome Project

In the research sector, the open science movement involves the removal of financial barriers to accessing academic publications, data and other products of research so they can be widely read and used by everyone in society: researchers, businesses, professionals, policymakers and citizens. The OECD (2016) calls open science the “next frontier” in scientific communication, and we are seeing widespread adoption of open science policies and practices by the research community around the world.

The Human Genome Project (HGP) is often held up as the model for open science, paving the way for a new culture of sharing and fundamentally altering the way we think about how to maximize the value of research beyond the scientific community. The \$3 billion project to work at the international level to sequence the human genome project was launched in 1990 (Human genomes, public and private, 2001). At that time, genomics scientists had been largely working behind closed doors, sharing their results through scientific articles only after significant time lags. However, the HGP partners quickly realized that if they shared their results more promptly, they could make much faster progress, avoid unnecessary duplication, and maximize the usefulness of the data. In a groundbreaking agreement, the organizations participating in the project committed to sharing their data publicly within a six-month period, and by 1996, significantly strengthened this policy to make all new sequencing data publicly available within 24 hours. By 2003 and two years ahead of schedule, they had deciphered all 30,000 genes in the human genome. Not only did public data sharing help to greatly accelerate the advancement of our scientific understanding of genomics, but it also had huge economic benefits. Although some in the community had argued that public sharing of the genomics data would be detrimental and restrict industry’s ability to commercialize and develop products, this was not actually the case. On the contrary, widespread access to the genomics data democratized and broadened the economic impacts of the project. Small and large companies alike were able to capitalize on the data in order to develop drug treatments and many other medical interventions. The Human Genome Project fundamentally changed the thinking around how to manage research outputs, and demonstrated that immediate public access to information can be the best way to ensure our investments are fully utilized.

Open science is now spreading across the entire academic community, with the adoption of open science policies and practices across countries and disciplines around the world.



Access alone is not everything – people need the skills to manage it, assimilate it and understand it.

6.4 Information is becoming the foundation for efficient infrastructure

Information also plays an increasingly important role in developing resilient and efficient infrastructures. Smart cities are a great example of how digital information can be used to improve public infrastructure and services. Smart cities gather data from devices and sensors embedded in roadways, power grids, buildings, mobile phones, and other locations. The data is then made available as the basis for digitally enhanced services supporting the development of quality, reliable, sustainable and resilient infrastructure to support economic development and human well-being (Smart Cities Council, 2013).

Santander, Spain, is known as the smartest smart city and a testing ground for new services built on open data. The city has been wired up with thousands of sensors, transforming it into a smart city laboratory. Santander’s Open Data website enables organizations to build services using the data collected by the city through these sensors and other means. The services fall into six categories: transportation, demography, public sector, commerce, society and welfare, and urban planning and infrastructure. Practical applications include apps that provide real-time information about parking, bus arrivals and bike sharing availability. They also alert city workers when pails are full and when grass needs to be watered (Spain’s Santander hailed as global pioneering ‘smart city,’ 2016). They have even developed a smartphone app, *SmartSantanderRA*, that includes information about 2,700 places in the city. The app provides real-time access to traffic and beach cameras, weather reports and forecasts, public bus information and bike-rental service, generating a unique ecosystem for citizens and visitors who walk around the city (SmartSantanderRA: Santander Augmented Reality Application, 2014).

Although smart cities are mostly associated with wealthy countries, smart technologies are also starting to be adopted in less developed countries, helping to support domestic technology development and research and innovation in those regions. Nairobi, Kenya, for example, will be one of the first African cities to adopt smart traffic technology. Traffic congestion has become a major issue for many cities around the world and ultimately results in the loss of productivity, wasted fuel, and negative health impacts from vehicle emissions,

not to mention the negative impact on quality of life as people spend an increasing amount of time in their cars. Nairobi is one of the world's most congested cities. Its road systems, which were built at a time when there were 350,000 people living there, are now being stretched to the limit to support a population of more than 3 million. This has resulted in huge traffic problems. To address this, Nairobi is installing new sensor-powered traffic lights that will use real-time data to assess traffic needs, changing lights when needed to ensure maximum efficiency of traffic flow (Smart Traffic in Kenya, 2017). Intelligent transport systems are also being adopted in many other less developed countries. Other countries such as India and Brazil are also starting to implement smart methods as a means to address their own unique infrastructure challenges (World Bank, 2015).

6.5 Embedding access to information into society

In 2015, UNESCO proclaimed September 28 as "International Day for the Universal Access to Information," in recognition that the universal right to information is essential for societies to function democratically and for the well-being of each individual (International day for universal access to information, 2016). The examples provided here help to illustrate the important role of information in creating knowledgeable citizens, improving research and innovation, ensuring greater accountability and developing more efficient infrastructure. For the local farmer who discovers new fertilizers to increase crop yield, for the municipal engineer who learns about new materials to strengthen roads and bridges, for the pharmaceutical business that mines large biomedical databases to develop new medicines, and for the city planner who analyzes data to improve public transportation – access to information is an essential element for efficiency, innovation and a strong economy.

In the digital environment, where it is so easy and (relatively) inexpensive to share information, the potential benefits are even greater. This is especially so for the less developed regions. Open science, for example, greatly boosts research capacity in all countries, but is especially valuable for scientists in less developed countries who often do not have funds to subscribe to the research literature in their field.

However, while the opportunities are enormous, there are still many challenges. People need the skills to manage information, including helping them to distinguish reliable information sources from those of dubious quality. They need access to the internet because most information is now digital; and they need to have it in a format that they can assimilate and understand. Moreover, there will be no slowdown in the explosion of information and data in the foreseeable future, presenting even greater potential benefits, but also exacerbating the issues of how to navigate and



Libraries are an essential part of the information ecosystem, and bridges across the information gap. With their mandate to acquire, preserve and give access to information, they are also essential to innovation.

extract value from vast quantities of content. To take full advantage of the benefits of information, we need to ensure that information is widely available. Moreover, inherent to the notion of sustainability is that we are contributing to the well-being of future generations. Sustainability implies a holistic approach to addressing problems that takes into account multiple dimensions including ecology, society and economics, recognizing that all of these dimensions must be considered together to find lasting prosperity. This means we need to foster the enabling conditions that will formalize and embed access to information into all sectors of society by implementing the appropriate policies, infrastructures, and capacity building activities. These components are central for ensuring the unimpeded flow and uptake of information over the long term.

Information intermediaries, such as libraries, are an important part of the information ecosystem and can help to address many of the challenges. Libraries bridge the information gap by offering services to everyone in their community. They provide universal and affordable access to the internet for underserved populations, and they teach people how to navigate and use information resources in an increasingly complex digital world. Libraries are also one of the few organizations with a mandate to preserve information over the long term. As we continue to advance the targets set out for the United Nations SDGs, we must remember that information is a fundamental pillar of sustainable development, and continue our efforts to firmly entrench their values and practices.

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