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spotlight

In Machines We Trust?

Data governance and the transformation of traditional sectors

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October 2022

Key Insights

1. The growing prevalence of internet of things (IoT) devices is leading to the **increased "datafication" of traditional sectors** such as agriculture, transport, energy, natural resources, and health. While this can be a benefit to society and the economy, it can also widen social inequities and increase economic gaps between countries.

2. The inevitable datafication of traditional sectors, which dominate most economies, is especially relevant to developing countries since they still lag digitally. To compete successfully in these sectors, **developing countries and the companies based in them must develop new and unique data assets** and create/update infrastructure and policy/regulatory measures to support new business models and operational processes.

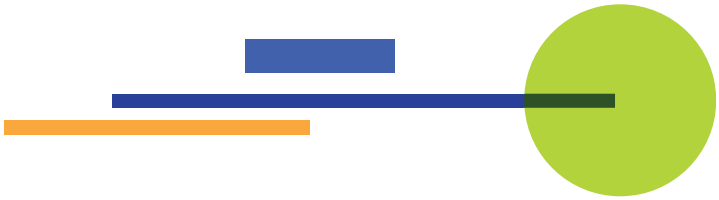
3. As traditional sectors datafy, the ubiquity and complexity of machine data will intensify debates around several data policy issues, including ensuring that the benefits of data outweigh its harms. **Policymakers must learn from the successes and limitations of the current data policy environment and consider requirements specific to developing countries.**

4. **The data policy space for machine data is still evolving,** with many issues still not fully resolved, such as the boundary between personal and nonpersonal data and the division of rights between device manufacturers and owners. Developing countries must participate actively in these debates, as they will have a direct impact on their traditional sectors.

5. A useful starting point for developing countries is to ensure that they **incorporate machine data and the datafication of traditional sectors into their national data strategies** and regulatory/institutional arrangements, while also addressing the opportunities and challenges posed by personal data-based businesses and services.

SECTION 1

Summary



Data is widely regarded as an asset for furthering social cohesion and equity, ensuring national security, and delivering public services more efficiently. However, it has different economic value for different countries, depending on their current levels of competitiveness in different sectors, positioning within regional and international markets, and the priorities and readiness of their innovation and entrepreneurship ecosystems. Two intersecting trends in the world of data will have far-reaching implications for data governance and provide new opportunities and challenges for developing countries.

1. The first is the explosive growth in machine data, which is data produced by IoT devices. Machine data has already outstripped human data in size, variety, and frequency and is growing at a staggering pace: 50% compound growth in the size of data flows every year, and 125 billion networked devices by 2025, according to one estimate.[1]

2. The second trend is the growing "datafication" of traditional sectors—those that were not "born digital" like social media—such as agriculture, transport, energy, natural resources, and health. Datafication is the use of data from IoT devices at each stage of an industry's value chain. The growing use of new forms of data by traditional sectors has widened the scope of the data economy, which has conventionally been dominated by firms, products, and services whose value proposition stemmed from gathering and monetizing personal data (e.g., Google and Facebook) or that provide largely virtual services in new sectors (e.g., FinTech and RegTech).

Establishing personal data-driven businesses—in the mold of currently dominant global digital platforms such as Google and Facebook—is not always feasible in most developing countries, where many firms often lag well behind international competitors in the collection and use of personal data. Developing countries, and their firms, need to explore and grow other types of data assets as well.

A pragmatic option for many developing countries may be to focus on creating new data assets through the deployment of IoT in traditional sectors – in which they may already have competitive advantages against traditional sectors in the developed world – and use this data to increase efficiency and productivity at different stages of the value chain in these sectors.[2] Datafication of sectors has the potential to create higher-value jobs, as the value-drivers in the sector shift towards services (see the illustration below). This phenomenon is sometimes described as "servification."[3] However, this is easier said than done. Developing countries face significant infrastructure, capacity, policy/regulatory, and institutional challenges in driving the transition towards new business models and operational processes in these sectors. The growth of machine data exacerbates these challenges and can widen the economic disparity between rich and poor countries, firms, and people, as well as accentuate harms to individuals and societies.[4]

Developing countries must consider the following as they create new governance structures to realize the benefits of datafication:

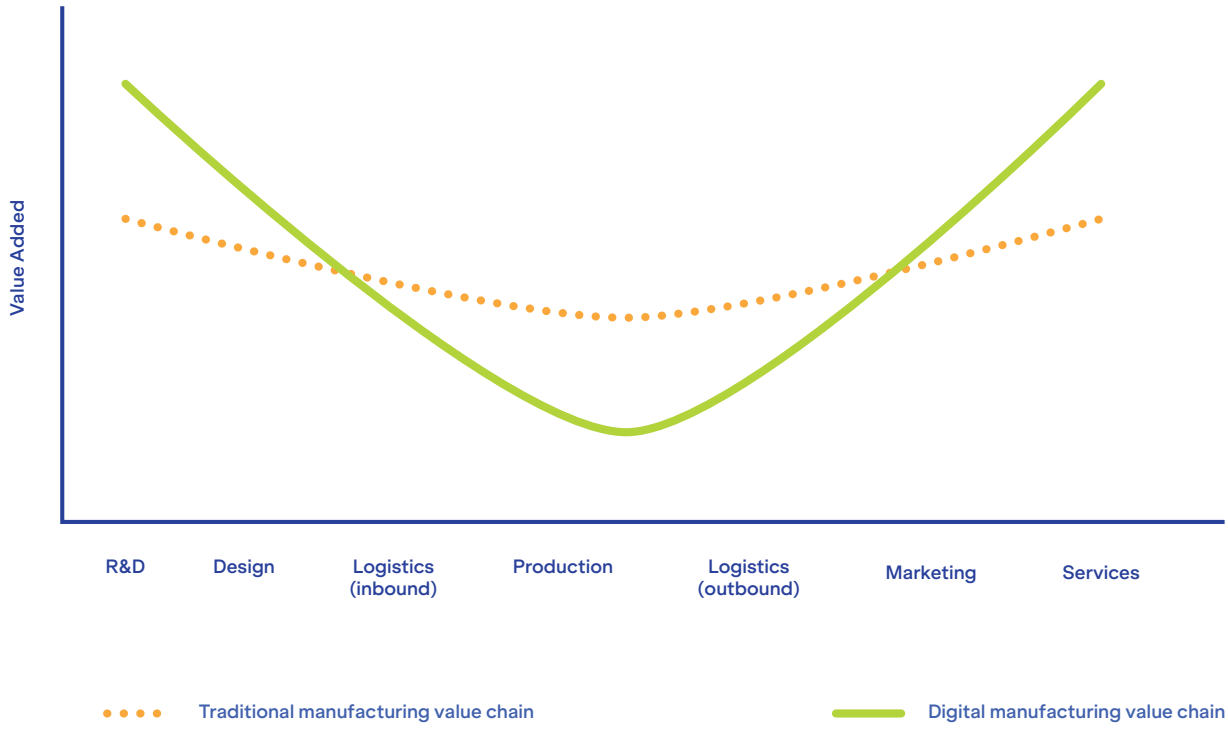
- How can they develop new and unique data assets that they control or manage, store and connect effectively, and make available to their citizens and firms at scale?

- How can they ensure that the benefits of datafication of traditional sectors are equitably shared and the interests of vulnerable and marginalized populations are effectively served?
- How can they ensure that a datafied economy and society is sustainable?

This paper provides more information on the trends and questions mentioned above and presents a potential framework and action plan to address the associated data governance opportunities and challenges.

> **Better data governance will be key to helping developing countries productively datafy their society and economies.**

Datafication can shift the locus of value creation in sectors[5]



SECTION 2

Key Trends: A Closer Look

Explosive growth of machine data

The datafication of traditional sectors has been led by the growing use of IoT during all stages of the value-chain of different industries. The following is a short primer on IoT.

What is IoT/machine data?

IoT refers to connected devices and machines that gather data, connect it with intelligent analytics, and adapt their behavior/responses[6] based on the information in the communication network. For example, a smart windmill with onboard sensors can gather real-time data on weather conditions, the performance of other windmills in the farm, and consumer demand, and use the information to adjust its performance. Smart windmills also report performance data that can be used for predictive maintenance.

What are common types of IoT and what data do they gather?

A mobile phone is an example of an IoT device containing many sensors. Other examples include smart cameras, thermostats, doorbells, drones, and satellites. IoT devices are used extensively in industrial settings and as part of public infrastructure (e.g., water pipes).

IoT devices gather both personal and nonpersonal data from private, public, and industrial spaces, and this can lead to problems with consent issues. Common types of data gathered by IoT devices are acceleration, force, flow, sound, vibration, humidity, temperature, motion, light, etc.

How does IoT/machine data help datafy traditional sectors?

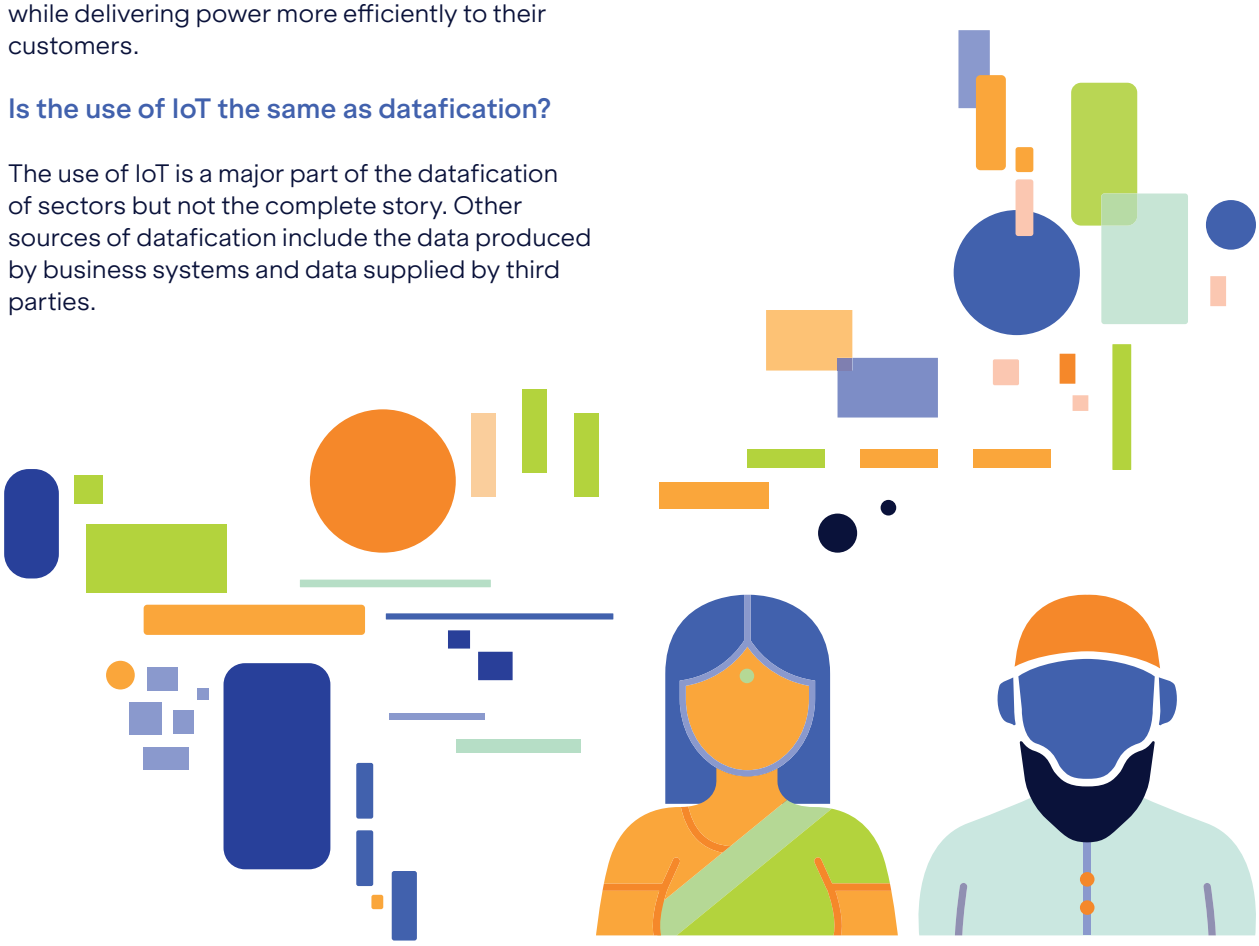
IoT devices are used extensively at every stage of the value chain in traditional sectors. Data from IoT devices is typically used to develop personalized/customized products, resource-efficient logistics, new services, and more flexible working environments. In agriculture, for instance, sensors are now used from farm to table. Livestock farmers use a variety of sensors, such as cameras, drones, and RFID tags to monitor the health and movement of animals, as well as sensors to gather humidity, temperature, and other ambient data. Farmers use similar data for precision agriculture—managing their crops and plants at the level of vines rather than fields. Sensors are also used to track produce as it is processed, packed, sold, shipped, and resold. The data produced and shared along the supply chain is critical for traceability and sustainability. Energy companies similarly deploy sensors in homes, along power lines, in public spaces, and in power plants to manage and maintain their infrastructure while delivering power more efficiently to their customers.

Is the use of IoT the same as datafication?

The use of IoT is a major part of the datafication of sectors but not the complete story. Other sources of datafication include the data produced by business systems and data supplied by third parties.

Are there any unique challenges to the adoption of IoTs in developing countries?

The deployment of IoTs has been relatively slow in developing countries for several reasons. At the technical level, many developing countries lack infrastructure such as reliable power supply or data centers, which are necessary for IoT deployment at scale. Unclear policies around the deployment of IoT in public spaces or the right to collect data using drones and other types of sensors hamper the growth of IoT. Many developing countries lack IT capacity or do not have the financial resources to utilize IoT at scale. Fortunately, the trendline is changing. IoT devices have grown steadily cheaper and are more adaptable to harsh climatic conditions, and the growth in the number of open-source services specifically for IoT has increased access to complementary technical resources. As noted in this paper, the policy environment is also maturing, with some suggesting that developing countries will account for 40% of the economic value added through IoTs[7] by 2025.



Machine data in traditional sectors

The datafication of traditional sectors—or the growing use of sensors at different stages of the value chain—is driven by many factors. The digital economy has reshaped many markets, and it's only been spurred on further by the ongoing pandemic.[8] In January 2020, the stock valuation of Tesla,[9] which treats each vehicle as a sensor[10] and has amassed more than 1 billion miles of autopilot data, roared past that of GM and Ford combined even though it sells 98% fewer cars. Additionally, consumer expectations have changed, with a greater demand for accountability, traceability, sustainability, ethical sourcing, and circular economy. Datafication, along with the general digital transformation, has also been hastened by increased labor disruptions, market volatility, supply chain stresses, resource scarcity, market competition, and regulatory complexity.

Below is an example drawn from the natural resources sector,[11] showing how data and data-driven technologies are being used to address challenges at each stage of the sector's value chain. Similar value chain datafication opportunities apply in many sectors.

VALUE CHAIN STAGE	DATA-DRIVEN BUSINESS MODELS AND PROCESSES
LOCATE/RECOVER/ THROUGHPUT	Artificial intelligence (AI) utilizing new data sources such as sensors or satellite images to make exploration more efficient
VALUE	Simulation of price trends and more accurate modeling of expenditures as a result of better data management
CONSTRUCT/MAINTAIN	Predictive and remote maintenance of equipment based on the constant flow of data from equipment
MINE	Use of data to develop digital twins that make operations such as ore mixing easier or create augmented reality (AR) and virtual reality (VR) learning materials
PROCESS	Using sensors for ore sorting to reduce mine waste and for process automation and control
SALES AND CUSTOMER RELATIONS	New data, including satellite imagery, to provide valuable insight into market trends (e.g., to track the volume of oil in storage)

The datafication of traditional sectors is not without challenges, even in advanced economies. The data collection itself has increased significantly, but the use, reuse, and sharing of this data is still not firmly established in the working processes and business models of many firms. Here are a few examples:

- In agriculture, "farmers don't just farm food, they also cultivate data[12]—from drones flying over fields to smart irrigation systems, and IoT sensors affixed to combines, seeders, sprayers, and other equipment." However, the average farmer rarely benefits directly from the roughly 500,000 points of data an individual farm generates.
- While data is increasingly viewed as an asset in the natural resources sector, companies typically use only 1% of the data[13] produced in mines while discarding the rest, a phenomenon akin to burning piles of money.[14]
- The amount of data collected by health care providers in the United States grew by an astounding 878% in the three years[15] after 2016, and that was before the pandemic, but another estimate claims that 97% of all data collected in hospitals is never used.[16]
- In the education sector, the chaotic rollout of online instruction around the world during the pandemic was marked by insecure virtual classrooms,[17] rampant concerns about the privacy of students, and debates about the effectiveness of online schooling, illustrating the sector's digital unpreparedness.

> **Governments have taken notice. The use of new forms of data and data-related analytics and infrastructure in traditional sectors is emerging as a clear theme in the digital strategy of several countries, both in the developed and developing worlds.**

Strategy documents typically list specific sectors in which the countries want to preserve or enhance existing competitive advantages. In some cases, they anticipate positioning in sectors and markets in which they see unexploited potential created by new market conditions through the digitalization of industries.

- The AI strategy of the UAE[18] specifically calls to "leverage physical and digital assets in two of its strongest existing sectors"—resources and energy, and logistics and transport—as part of adopting and trialing data-driven growth in the country.
- A proposal for a national data strategy in Canada[19] emphasizes sectors of interest, such as energy, mining, and agriculture, and specifies that "just as Uber and Airbnb identified and capitalized on unutilized capacity in vehicle and housing stocks, Canadian companies should seek ways to generate data—and valuable knowledge—from the trucks, drills, conveyors and processors that are already out in the field."
- The European data strategy[20] proposes to "pool European data in key sectors, with EU-wide common and interoperable data spaces." It defines data spaces as "data infrastructure with tailored governance mechanisms that will enable secure and cross-border access to key datasets in the targeted thematic area." Its follow-up, the Data Governance Act,[21] was approved in May 2022 and is expected to "pave the way for sectoral European data spaces to benefit society, citizens and companies." The European data strategy envisions nine such data spaces, ranging from manufacturing to energy, and from health to the European Green Deal.
- The proposed AI strategy for India[22] takes a sectoral approach, highlighting the potential for "societal growth" in priority sectors such as health care, agriculture, education, smart cities and infrastructure, and smart mobility and transportation.
- The Made in China 2025 strategy[23] identifies 10 priority sectors, including aviation, advanced manufacturing, and energy, and seeks to support "not only future-oriented but also traditional industries."
- In Kazakhstan, digitization of industry[24] is one of the core focus areas of the country's digital strategy, which identifies mining—a core sector in Kazakhstan—as an immediate priority, followed by digitization of transport and logistics.
- In the same vein, an ongoing study by DIAL in Sierra Leone has surfaced a clear desire by the government to focus on sectors such as agriculture, education, and health care as part of its plans for digital transformation.

Yet, the transition from digital strategy to functioning laws and regulations that are backed by appropriate institutions focused on the digital transformation of specific sectors is still nascent in most developing countries, which, in many cases, are still struggling to institute essential data privacy and protection measures.[25] A recent survey showed that only 43% of the least-developed countries have passed relevant data privacy and protection legislation, and the data for actual enforcement is likely to be even more bleak. Machine data is typically not a major part of the first wave of such legislation, and it is fair to conclude that the relevant policy environment in most developing countries is still at an early stage.

SECTION 3

The Implications for Data Governance

The key questions that developing countries must consider as the datafication of traditional sectors gathers pace globally include:

- How can they develop new and unique data assets that they control or manage, store and connect effectively, and make available to their citizens and firms at scale?
- How can they ensure that the benefits of datafication of traditional sectors are equitably shared and that the interests of vulnerable and marginalized populations are effectively served?
- How can they ensure that a datafied economy and society is sustainable?

The appendix at the end of this paper provides a generalized framework and list of data policy issues relevant to the datafication of traditional sectors. A future DIAL report will provide a more comprehensive assessment of the preparedness of developing countries to tackle the entire range of themes presented in the framework.

Generation of, control over, and access to data assets

Data economy proponents in developing countries face a fundamental paradox: How do you build a data-driven society and economy without data? While the world is awash in data, developing countries are still "data deserts" in comparison to the developed world. The gaps in traditional data collection by national statistical offices[26] in developing countries have long been recognized. New studies and reports illustrate the challenges that developing countries confront in the new data economy driven by IoT.

Where the data is and who controls it. Most developing countries have data deficits, putting them at an immediate disadvantage in the data economy. For example, an average farm in a developed country generates half a million data points per day,[27] which are then used to improve yields and productivity. Conversely, the vast majority of farms in developing countries utilize very few sensors, if any. The limited data that is collected is often done so by international organizations or multinational firms, which take the data out of countries and communities without the knowledge or consent of data subjects,[28] who then do not have the means to benefit from this data, a process sometimes described as "data colonialism." Unsurprisingly, the number of data localization policies has doubled in the last four years,[29] with China, Russia, Indonesia, and South Africa among the most restrictive countries. In Europe, policymakers have been clear about protecting and keeping data within the European Union, and to the surprise of many, the U.S. government has recently proposed measures[30] to prevent rivals such as China from gaining access to American data.

Where to store the data. The global data storage infrastructure is unevenly distributed, with developing countries and the firms located within them extremely reliant on data storage facilities provided by firms and infrastructure located in developed countries. One study estimates that the United States accounts for almost 40% of all global data storage sites,[31] with another five countries accounting for an additional 30%. California alone has more data centers than all of sub-Saharan Africa.[32] Amazon, Google, and Microsoft manage more than 50% of the world's data centers, while Chinese firms operate the world's largest ones. This leaves developing countries in a tenuous position, especially as concerns about data localization and sovereignty[33] mount and regulations around the transfer of personal data across national boundaries become restrictive. In a welcome sign, the digital strategies of many developing countries such as Nigeria[34] and Vietnam[35] include provisions for data centers and cloud services, though the focus is often limited to government data.

> **How do you build a data-driven society and economy without data?**

How to connect people, machines, and spaces (personal, public, industrial). While developing countries have recently taken great strides to connect their populations to the internet, the proliferation of IoT devices and the spread of techniques such as edge computing, which gives sensors the ability to process data and act autonomously based on data they capture, means that countries and firms must quickly transition to 5G networks. The 5G rollout in most developing countries is still at a nascent stage,[36] especially in Africa, and has not yet reached the scale necessary to datafy the traditional sectors of the economy.

How to "platformize" the data and equalize access. As traditional sectors become more datafied, smaller firms and start-ups will require access to vast quantities of data and data tools so they can compete effectively with larger and better resourced competitors. Shared data and tools at scale—often delivered through platforms—can reduce the time and resources necessary to develop products and services and take them to market or deliver them to citizens. One example is in the deep tech sector, where businesses can use vast databases of labeled data[37] that include data on face, gesture, pose, and activity recognition, and databases of molecules for material science and pharma. Instead of building an algorithm, a chemical solution, or another core technology from scratch, new companies use the existing tools and insights as building blocks to fast track the overall commercialization cycle. The process is facilitated by data exchange platforms such as Dawex[38] that make it easy for a range of stakeholders to pool data and establish rules for use and reuse. While countries such as India have begun to develop large-scale computing platforms,[39] most developing countries still lag behind. However, the urgency of the issue is now recognized in policy initiatives such as the proposed data and cloud policy in South Africa.[40] Related initiatives such as GovStack,[41] in which DIAL is a partner, can also offer the technical infrastructure to establish such platforms in developing countries.

Equitable distribution of benefits and the protection of the vulnerable, dispossessed, and marginalized populations

While not universally true, the "winner take all" tendency has been one of the characteristics of the data economy, in which the spoils go to a few, leading to social and economic inequality and the increased marginalization of large sections of the population. Policymakers focused on the datafication of the traditional sectors of the economy—and the concomitant expansion in the collection of data from private, public, and work spaces—must focus on the following issues to reduce data inequalities and maximize opportunities for all.

How to make sure that the data represents everyone and respects their data rights.

Paradoxically, even as the volume of data has increased, the representation of marginalized groups in the data has not kept pace often "because they are less involved in the formal economy and its data-generating activities [or because they] have unequal access to and relatively less fluency in the technology necessary to engage online."[42] Groups are frequently rendered invisible in data due to historical biases that are only slowly being rectified, as in Europe where LGBTQ populations are often not featured in national datasets.[43] The debate around the caste census in India[44] is another example of historically unresolved socio-political issues that may eventually lead to data gaps.

When included in data production, many groups report a loss of agency. In the European Union for instance, a report found that "refugees' informed consent for the collection and use of their personal data is rarely sought."[45] Women have a similarly fraught relationship with data, highlighted by numerous gender data gaps[46] and the misuse of data for online harassment,[47] doxxing,[48] and cyberstalking.[49] The data rights of children have not been immune from abuse either, even by major corporations. YouTube has been accused of collecting personal information about children[50] by using persistent identifiers that track those who view child-directed channels without first notifying parents and getting their consent. Systematic gaps in data collection create fertile ground for exclusion and discrimination, as has been noted in many contexts, such as racially biased AI tools.[51]

The proliferation of IoT exacerbates questions about the agency and rights of data subjects and the ethical use of data. As smart home services become popular, so do the number and diversity of data collection devices in homes (e.g., lights, speakers, TVs, doorbells, thermostats, robots) and on people (e.g., wearables). Facial recognition cameras in public spaces are the poster child for intrusive and sometimes discriminatory data collection.[52] Privacy concerns abound in industry settings as well, and they will become more prominent as traditional sectors datafy. For example, many miners carry or wear several sensors that collect a large amount of environmental or ambient data, but they also measure the behavior of the miner. Similarly, devices capture data about operators of plant machinery and can report when these workers are fatigued or delinquent.

This type of machine data and the boundary between personal and nonpersonal data are important themes in India's data privacy and protection discussions. In July 2020, a committee of experts appointed by India's Ministry of Electronics and Information Technology (MeitY) proposed a governance framework for nonpersonal data[53] (NPD framework), which argued against separate regulations governing privacy for personal and nonpersonal data, machine generated or otherwise.

An Australian government report highlights privacy concerns heightened by IoT[54] in work and personal settings:

- **Consent**—IoT devices rarely provide adequate ways of ensuring that consent is voluntary, informed, current, or specific. In fact, users often do not even have the capacity to offer or circumscribe consent.
- **Collection, use, and disclosure**—IoT devices collect data at a highly granular and high-frequency level, can share it with other organizations and devices almost instantly, and make highly personal inferences with the data. For example, a smart speaker might overhear a conversation about your health and coordinate with other devices to show medical ads.
- **Deidentification**—The highly granular and longitudinal nature of IoT data means that it can thwart the best attempts to anonymize it, leading to numerous potentially adverse outcomes.
- **Accountability and transparency**—The opaque nature of data collection and sharing, the loose security of many networks, and the limited interoperability of many devices mean that it can be hard to trace bad actors and hold them accountable.

The policy response to questions of data representation, loss of agency, and systematic bias has been varied. (IoT specific issues have only recently been added.) Frameworks such as the European Union's General Data Protection Regulation (GDPR)[55] and the Personal Information Protection Act in South Korea[56] include specific consent provisions and measures to counter data bias and loss of agency but do not directly address machine data-related issues. Many developing countries are in the process of enacting similar laws, but it is still unclear how effective such laws can be in the absence of adequate institutional preparedness. Many proposed laws have also been criticized for being insufficient or carving out too many exceptions in the name of security and other constraining requirements.

Simultaneously, data ethics has emerged as a tool to address the moral dimensions of data, with numerous countries and organizations striving to develop new frameworks. One Swedish chief data officer even quipped that "if data is the new oil, data ethics is the new green." However, developing countries have been slower to adopt or formulate data ethics principles than more economically advanced nations. A recent study found that the world of AI ethics is very asymmetrical,[57] with the United States and the United Kingdom accounting for a third of the ethical principles, while no African or South American countries were included in its database.

How to create and protect jobs in datafied sectors. Policymakers, especially in developing countries, are frequently concerned about the disruptive potential of the datafication of traditional sectors, where most jobs tend to be. For example, the agriculture sector employs 63% of the world's poor people[58] and accounts for 25% of the GDP in many countries. So the question of how datafication might affect these jobs is critical.

In developed countries, early evidence suggests that automation does replace labor for many tasks, such as food processing. However, new jobs are created in specialized roles,[59] such as marketing, precision agriculture, data analysis, and operation of digital technologies. Some observers contend that the scenario may not be as optimistic in developing countries, where land holdings tend to be small, and farmers may not have access to education and training in digital agriculture and may not immediately see the benefit of datafication.

The structural transformation in these countries is thus likely to be gradual[60] and may widen digital divides in the short term. The evidence from other sectors is still unclear, but most projections balance job losses due to automation with new service jobs. For example, a study of the energy sector contends that while technology will displace many jobs, digitalization can create millions of new jobs[61] in areas such as energy storage integration, smart asset planning, and asset performance management. Most of these jobs rely on and utilize data produced by IoT.

The policy response in developing countries must include job training programs and investments in skill development, so workers can harness the labor-augmenting force of datafication and find new jobs in datafied sectors. Other issues to

consider include safety nets for workers who lose jobs and the strengthening of social protection and welfare systems. Governments should also consider the contractual instability of many new digital jobs and address new types of employment relationships and statuses where possible.

How to make IoT data markets fairer. As IoT devices take center stage in homes, offices, industrial settings, and public infrastructure, policymakers have begun to consider related data access and sharing questions and their impact on markets. Earlier in 2022, the European Commission proposed the Data Act,[62] which contains specific measures aimed at connected devices and the data generated by them. Key provisions include allowing users of connected objects access to the data and the right to share it with third parties, making contractual arrangements between the manufacturers and users of connected devices fairer, and providing clearer access rights to public agencies in cases of emergencies. The European Digital Markets Act[63] takes aim at dominant or "gatekeeper" firms, forcing them to share data with smaller competitors.

Developing countries have also begun to take notice of data market iniquities. The Competition Commission of South Africa recently released findings that Google's business practices distort competition,[64] among other things, and recommends that Google allow rivals to "compete for prominence" in search results. The report also noted "extreme levels of fee discrimination" against SMEs on all major platforms.

This is an issue that is likely to gain greater prominence as datafication of traditional sectors forces incumbents out, as happened in the advertising and retail sectors, or creates dominant firms with a disproportionate share of the market. The Google of agriculture or health care has not emerged yet, but that has not stopped dominant digital firms from betting big that their data smarts can disrupt the market structure of traditional sectors.[65] Policymakers in developing countries must anticipate and learn from the experience of the digital sector.

> **The structural transformation in these countries is thus likely to be gradual and may widen digital divides in the short term. The evidence from other sectors is still unclear, but most projections balance job losses due to automation with new service jobs.**

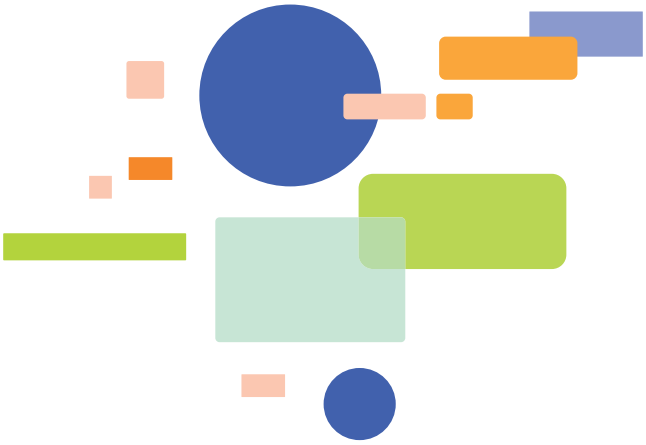
The new sustainability questions raised by the datafication of sectors

As traditional sectors become datafied, countries and the firms within them must consider sustainability questions. On one hand, data sharing and use can reduce environmental impacts, improve the measurement of initiatives, increase the participation and sway of a greater diversity of stakeholders, enhance resilience, reduce energy consumption, and create new business opportunities. On the other hand, many data technologies, such as data centers and blockchain, are extremely energy intensive, and the datafication of sectors is likely to magnify their negative environmental impact. According to one estimate, the carbon footprint of digital technologies is already comparable to that of aviation[66] and growing rapidly. In another comparison with aviation, a study by the United Nations Environmental Program (UNEP) estimated that "in 2019, a record 53.6 million metric tons (Mt) of e-waste were produced, the equivalent weight of 125,000 Boeing 747 jumbo jets—which is more than all of the commercial aircraft ever created. This makes e-waste the world's fastest-growing domestic waste stream."[67]

The policy response to the sustainability questions raised by digital transformation is still in its early days. The EU Green Energy Declaration[68] commits a group of large companies to participate in the fight against climate change. Similar coalitions are being established in the developing world as well, but the progress has been spotty. Policy issues gaining attention include green supply chains in the ICT sector, greater use of renewable energy by data centers or their relocation to renewable rich geographies, extending the lifespan of ICT equipment, and creating certifications for green data technologies. Some countries, such as China, also see a business opportunity in developing data-driven products and services aimed at helping firms and countries reduce their environmental impact.

SECTION 4

The Way Forward for Developing Countries



This report provides several examples of the unique challenges and opportunities posed by the growth of IoT and the concomitant datafication of traditional sectors. Advanced economies have taken the lead in responding to policy questions most relevant to them, but many developing countries are still in the early stages of formulating their data/digital strategies, and their approach is sometimes colored by the major policy debates in developed countries. It is important for these developing nations to consider the implications of the datafication of the sectors they are currently competitive in, as well as those sectors and markets where they see opportunity created by machine data, and that includes addressing the risks and harms. Starting points include:

- **Polices/regulations that encourage the development of new and unique data assets in traditional sectors and the infrastructure/environment for countries and firms to maximize their potential.** Options include clarity around the use of IoT devices for data collection, data rights and consent provisions, cross-border data transfer requirements, and the development of better data storage and computing infrastructure.
- **Policies/regulations that consider the impact on jobs, social equity, and the competitive distribution of benefits among firms.** Options include data rights and consent provisions, job training programs and investments in skill development, safety nets for workers who lose jobs, the strengthening of social protection and welfare systems, and measures designed to increase competition and fairness in data markets.
- **Policies and/or regulations that ensure sustainability.** Options include green supply chains in the ICT sector, greater use of renewable energy by data centers or their relocation to renewable rich geographies, extending the lifespan of ICT equipment, and creating certifications for green data technologies.

SECTION 5

Appendix

Key data governance issues and the datafication of sectors

One way to group the key themes in policy discussions around the datafication of traditional sectors and the regulation of machine data is with the following framework:

1. **Foundations:** The essential technical infrastructure
2. **Trust/control:** The institutional, social, and human infrastructure
3. **Application:** The environment to maximize the utilization of data and value creation

Foundations

- Infrastructure to manage the enormous real-time data collection and processing requirements of machine data
- Computational platforms that provide the tools, algorithms, and resources for firms and government agencies to use data successfully and at scale
- Data exchanges that provide the technical mechanism for organizations to control the use of their data while benefiting from data made available to them and others under controlled conditions, such as Dawex
- Open architecture and standards to enable the interoperability of data produced by a dazzling array of IoT devices
- Security, which is routinely considered the foremost problem with the current generation of many IoT devices

Trust/Control

- Data privacy provisions that specifically aim at new concerns raised by the prevalence of IoT devices in spaces both private and public
- Data intermediaries that act as trusted partners for the providers, collectors, and users of data
- Data sovereignty provisions that stipulate how and what data travels across borders and under what conditions
- Algorithmic transparency to ensure that machine data-based products and services are human centered and promote social good
- Sustainability and environmental impact
- Social protection, including jobs/labor issues
- Equity/participation/nondiscrimination issues

Application

- Sectoral data policies aimed at specific requirements of each sector, such as data spaces
- Innovation and entrepreneurship tools with an emphasis on machine data
- Provisions that promote the responsible use of data and AI in particular
- Resolving the data paradox; ensuring that the data collected is actually used and simultaneously addressing the numerous data gaps that continue to persist despite the general data explosion

Endnotes

1 "The Internet of Things: a movement, not a market," https://cdn.ihs.com/www/pdf/IoT_ebook.pdf.

2 "Digitizing the agricultural value chain | WHY," https://www.usaid.gov/sites/default/files/documents/15396/Why_Where_and_How_Digital_Tools_Impact_the_Value_Chain.pdf.

3 "The Servification of Manufacturing in Asia: Redefining the Sources of Labor Productivity," https://www.adb.org/sites/default/files/publication/471531/adbi-wp902.pdf.

4 "Digital Trends Carry Extra Risks for Emerging Markets," https://futurestate.org/2018/05/digital-trends-carry-extra-risks-for-emerging-markets/.

5 "Industrial Policy in an hyper-connected world," https://www.cepal.org/sites/default/files/events/files/11_cimoli_eclac.pdf.

6 "Internet of Things: The New Government-to-Business Platform," https://openknowledge.worldbank.org/handle/10986/28661.

7 "Challenges and Opportunities of the Internet of Things for Global Development to Achieve the United Nations Sustainable Development Goals," https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9004570.

8 "How COVID-19 has pushed companies over the technology tipping point—and transformed business forever," https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever.

9 "Tesla Is More Valuable Than GM, Ford Combined – Despite Selling 98% Fewer Cars," https://observer.com/2020/01/tesla-stock-rise-market-cap-100b-top-gm-ford-volkswagen/.

10 "Tesla, the data company," https://www.cio.com/article/3433931/tesla-the-data-company.html.

11 "Unlocking Data Innovation for Social License in Natural Resources," https://commdev.org/publications/unlocking-data-innovation-for-social-license-in-natural-resources/.

12 "IBM AI and Cloud Technology Helps Agriculture Industry Improve the World's Food and Crop Supply," https://newsroom.ibm.com/2019-05-22-IBM-AI-and-Cloud-Technology-Helps-Agriculture-Industry-Improve-the-Worlds-Food-and-Crop-Supply.

13 "How digital innovation can improve mining productivity," https://www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity.

14 "When data is capital: Datafication, accumulation, and extraction," https://journals.sagepub.com/doi/pdf/10.1177/2053951718820549.

15 "Organizations See 878% Health Data Growth Rate Since 2016," https://hitinfrastructure.com/news/organizations-see-878-health-data-growth-rate-since-2016.

16 "4 ways data is improving healthcare," https://www.weforum.org/agenda/2019/12/four-ways-data-is-improving-healthcare/.

17 "Tech glitches, harassment mar Fairfax County schools' online learning rollout," https://www.washingtonpost.com/local/education/fairfax-schools-online-harassment/2020/04/15/841b0406-7f3b-11ea-9040-68981f488eed_story.html.

18 "UAE National Strategy for Artificial Intelligence 2031," https://ai.gov.ae/wp-content/uploads/2021/07/UAE-National-Strategy-for-Artificial-Intelligence-2031.pdf.

19 "A National Data Strategy for Canada: Key Elements and Policy Considerations," https://www.cigionline.org/publications/national-data-strategy-canada-key-elements-and-policy-considerations/.

20 "The European Data Strategy," https://ec.europa.eu/commission/presscorner/detail/en/fs_20_283.

21 "Council approves Data Governance Act," https://www.consilium.europa.eu/en/press/press-releases/2022/05/16/le-conseil-approuve-l-acte-sur-la-gouvernance-des-donnees/.

22 National Strategy for Artificial Intelligence," https://indiaai.gov.in/research-reports/national-strategy-for-artificial-intelligence.

23 "Made in China 2025 — A Halftime Analysis," https://medium.com/china-tech-blog/made-in-china-2025-a-halftime-analysis-ab0e27083298.

24 "Digitalization of economic branches," https://digitalkz.kz/en/digitalization-of-economics/.

25 "Data and privacy unprotected in one third of countries, despite progress," https://unctad.org/news/data-and-privacy-unprotected-one-third-countries-despite-progress.

26 "Stuffing data gaps with dollars: What will it cost to close the data deficit in poor countries?" https://www.brookings.edu/opinions/stuffing-data-gaps-with-dollars-what-will-it-cost-to-close-the-data-deficit-in-poor-countries/.

27 "Smart Farming in 2020: How IoT sensors are creating a more efficient precision agriculture industry," https://www.businessinsider.com/smart-farming-iot-agriculture.

28 "Data colonialism: rethinking big data's relation to the contemporary subject," https://eprints.lse.ac.uk/89511/1/Couldry_Data-colonialism_Accepted.pdf.

29 "How Barriers to Cross-Border Data Flows Are Spreading Globally, What They Cost, and How to Address Them," https://itif.org/publications/2021/07/19/how-barriers-cross-border-data-flows-are-spreading-globally-what-they-cost/.

30 "The Era of Borderless Data Is Ending," https://www.nytimes.com/2022/05/23/technology/data-privacy-laws.html?referringSource=articleShare.

31 "Microsoft, Amazon and Google Account for Over Half of Today's 600 Hyperscale Data Centers," https://www.srgresearch.com/articles/microsoft-amazon-and-google-account-for-over-half-of-todays-600-hyperscale-data-centers.

32 "Improving data infrastructure helps ensure equitable access for poor people in poor countries," https://blogs.worldbank.org/opendata/improving-data-infrastructure-helps-ensure-equitable-access-poor-people-poor-countries.

33 "Sovereignty and Data Localization," https://www.belfercenter.org/publication/sovereignty-and-data-localization.

34 "National Digital Economy Policy and Strategy (2020-2030) – For a Digital Nigeria," https://www.ncc.gov.ng/docman-main/industry-statistics/policies-reports/883-national-digital-economy-policy-and-strategy/file.

35 "National strategy for development of digital economy and digital society to 2025, orientation to 2030," http://www.asemconnectvietnam.gov.vn/default.aspx?ZID1=3&ID1=2&ID8=118296.

36 "Which countries have rolled out 5G in Africa?" https://qz.com/africa/2168658/which-countries-have-rolled-out-5g-in-africa/.

37 "Deep Tech Solutions for Emerging Markets," https://www.ifc.org/wps/wcm/connect/publications_ext_content/ifc_external_publication_site/publications_listing_page/deep+tech+solutions+for+emerging+markets.

38 "Data Exchange, unleash the value of your data," https://www.dawex.com/en/.

39 "India Urban Data Exchange: Unleashing the Power of Data for Public Good," https://iudx.org.in/.

40 "Electronic Communications Act: National Data and Cloud Policy: Comments invited," https://www.gov.za/sites/default/files/gcis_document/202104/44389gon206.pdf.

41 See: https://www.govstack.global/.

42 "Big Data's Disparate Impact," http://www.datascienceassn.org/sites/default/files/Big%20Data%27s%20Disparate%20Impact.pdf.

43 "Data collection in relation to LGBTI People: Analysis and comparative review of equality data collection practices in the European Union," https://ec.europa.eu/newsroom/just/document.cfm?action=display&doc_id=45790.

44 "Caste census: Clamour to count India social groups grows," https://www.bbc.com/news/world-asia-india-58141993.

45 "World Refugee Council," https://www.worldrefugeecouncil.org/sites/default/files/documents/WRC%20Research%20Paper%20no.12.pdf.

46 "Mapping Gender Data Gaps," https://data2x.org/resource-center/mapping-gender-data-gaps/.

47 "Trolling Verified: Troll Patrol India's Finding on Online Abuse," https://amnesty.org.in/trolling-verified-troll-patrol-indias-findings-on-online-abuse-twitter/.

48 "What we still haven't learned from Gamergate," https://www.vox.com/culture/2020/1/20/20808875/gamergate-lessons-cultural-impact-changes-harassment-laws.

49 "Former eBay executive charged with cyberstalking," https://www.ft.com/content/ecfecdde-ac79-4ead-aaba-1b32d958f68a.

50 "Children's Online Privacy Protection Rule ("COPPA")," https://www.ftc.gov/enforcement/rules/rulemaking-regulatory-reform-proceedings/childrens-online-privacy-protection-rule.

51 "How Artificial Intelligence Can Deepen Racial and Economic Inequities," https://www.aclu.org/news/privacy-technology/how-artificial-intelligence-can-deepen-racial-and-economic-inequities.

52 "Police surveillance and facial recognition: Why data privacy is imperative for communities of color," https://www.brookings.edu/research/police-surveillance-and-facial-recognition-why-data-privacy-is-an-imperative-for-communities-of-color/.

53 "Report of the Joint Committee on the Personal Data Protection Bill, 2019 – Seventeenth Lok Sabha," https://www.ahlawatassociates.com/wp-content/uploads/2021/12/17-Joint-Committee-on-the-Personal-Data-Protection-Bill-2019.pdf.

54 "Internet of Things and Privacy – Issues and Challenges," https://ovic.vic.gov.au/privacy/internet-of-things-and-privacy-issues-and-challenges/.

55 "Handbook on European data protection law – 2018 edition," https://fra.europa.eu/sites/default/files/fra_uploads/fra-coe-edps-2018-handbook-data-protection_en.pdf.

56 "Personal Information Protection Act (General Law)," https://www.privacy.go.kr/eng/laws_view.do?nttId=8186&imgNo=3.

57 "The global landscape of AI ethics guidelines," https://www.nature.com/articles/s42256-019-0088-2.

58 "A lack of basic agricultural data is holding African countries back," https://www.fao.org/family-farming/detail/en/c/1412330/.

59 "Employment Opportunities for College Graduates in Food, Agriculture, Renewable Natural Resources and the Environment," https://www.purdue.edu/usda/employment/.

60 "Farmer Ex Machina: Is digital agriculture the beginning of the end of agricultural employment?," https://blogs.worldbank.org/jobs/farmer-ex-machina-digital-agriculture-beginning-end-agricultural-employment.

61 "Electricity: generating value through digital transformation," https://reports.weforum.org/digital-transformation/electricity-generating-value-through-digital-transformation/.

62 "Data Act: Commission proposes measures for a fair and innovative data economy," https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1113.

63 "Digital Markets Act," https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=en&reference=2020/0374(COD).

64 "Digital Markets Inquiry Releases Its Provisional Report," https://www.compcom.co.za/wp-content/uploads/2022/07/Media-Advisory-Online-Platforms-Market-Inquiry-Provisional-Report-final_.pdf.

65 "18 things to know about Google in healthcare for 2020," https://www.beckershospitalreview.com/healthcare-information-technology/18-things-to-know-about-google-in-healthcare-for-2020.html.

66 "Lean ICT – Towards Digital Sobriety – Report of the Working Group Directed by Hughes Ferreboeuf for the Think Tank The Shift Project (March 2019)," https://theshiftproject.org/wp-content/uploads/2019/03/Lean-ICT-Report_The-Shift-Project_2019.pdf.

67 "The growing footprint of digitalisation," https://wedocs.unep.org/bitstream/handle/20.500.11822/37439/FB027.pdf.

68 "European Green Digital Coalition," https://digital-strategy.ec.europa.eu/en/policies/european-green-digital-coalition.