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1 ton of CO_2 offset
One Earth

Voices

Digitizing a sustainable future

Digital technologies have a crucial role in facilitating transitions toward a sustainable future. Yet there remain challenges to overcome and pitfalls to avoid. This Voices asks: how do we leverage the digital transformation to successfully support a sustainability transition?

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Digital sovereignty for sustainable consumption

Although there is no commonly accepted definition, digital sovereignty (DS) usually describes the degree of control that individuals, organizations, or governments have over the data they generate and use. The Council of Advisors on Consumer Affairs to the German government (which I chaired from 2014 to 2018) carved out early what DS as a political measure means and how it can contribute to a sustainable and resilient society via sustainable consumption, a key target of SDG 12. DS means citizens' ability and freedom to act as market participants, such as consumers and/or prosumers. This includes the capability, skills, and self-control to decide what and how to consume on the basis of historical consumption data, to make as informed and sustainable a choice as possible, and to not fall prey to manipulative forms of website advertising and personalized profiling, counteracting so-called "dark patterns." It underscores the conditions under which citizens can freely use digital media and services competently and responsibly, thus enabling and empowering them to participate. This type of access to information and action is of particular relevance for those in the less affluent countries in the Global South. Policies promoting an environmentally and socially sustainable digital consumption have three entry points: regulatory measures promoting fair and equal access for all, avoiding monopolies of thought and power; the support of green technology, including "lean" artificial intelligence and machine learning; and the empowerment of digital literacy, providing a shield against manipulative mindless and wasteful overconsumption.

Lucas Joppa
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An objective function for Earth

History, if there is a future in which to write it, will show that modern society lives a double life. Viewed through one lens, we are entrenched in the Anthropocene, defined by the negative impacts of human activities on Earth's natural systems. A second lens reveals another truth, this one of an unprecedented Information Age and a dizzying array of technological advances that continuously enhance the overall human experience. We must focus through both lenses if we are to realize a trajectory toward a more sustainable future. The most effective and efficient way to do this is to follow a path we know well—for humans to define a societal objective and to put technology to work in pursuit of that outcome. Digital technology has the power to collect, sort, store, analyze, and optimize over nearly infinite amounts of data. At Microsoft, we are building a "planetary computer" that combines massive datasets, scalable computing power, advanced algorithms, and sophisticated end-user applications. Although putting the planetary computer to work to monitor and model the planet is a relatively straightforward task for technology, managing Earth's natural systems is a job for people—one that requires developing a shared objective function for Earth that computation can help solve. Technology can help minimize our species' negative impacts on our planet and maximize our overall human experience. But we must first decide that this is an outcome we all desire and work together to achieve it.

Peter Howson
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Beyond business as usual with blockchain technology

When we think about the game-changing digital innovations of the last decade, blockchain should be near the top of the list. These append-only distributed databases are providing the infrastructure for a wide range of applications relevant to environmental sustainability. Everything from distributed-energy microgrids to environmental asset marketplaces, fish supply-chain provenance systems, and digital community currencies often all have a blockchain behind them. But blockchains also sit behind wasteful cryptocurrency experiments, such as Bitcoin. This is because blockchains replace the need for trust between people with a need for distributed webs of computers and electrical energy. Even so, innovators have often rushed toward blockchain as a techno-fix to solve environmental crises. But such crises are almost always political in nature rather than technical. Conservationists and digital innovators must be mindful that a blockchain cannot fix complex political problems. Blockchains usually exist when people do not trust their institutions or even each other. Using "trustless" systems to enable the exchange of things between users who are indifferent toward building strong, trusting communities will ultimately lead to unsustainable and socially divisive outcomes. Our goal should not be to use blockchain to mask business as usual. But we should be open to using the technology if it supports ecologically sustainable, redistributive local economies while countering domination and social disconnection. For sustainable futures, trust must be built before a blockchain.

Artur Gil
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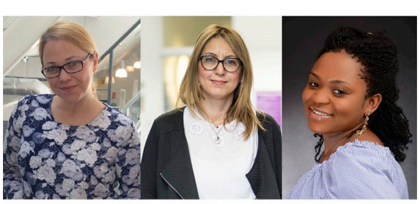
Open geospatial data for the greater good

The space conquest that began in the second half of the 20th century had a huge direct effect on the development of Earth observation, which ensured the ability to deepen our knowledge of the planet drastically and to be able to monitor it in near real time.

This ability to observe Earth from space, coupled with computational technological evolution, has also led in recent years to the creation of an unprecedented volume of geospatial data with the ability to support better decision making regarding key socio-environmental challenges (e.g., climate change, food security, and water resource management).

Open and permanent access to robust, accurate, and reliable geospatial data and products (at the local, national, and regional levels) by all sectors of society is thus essential for achieving the UN Sustainable Development Goals (SDGs).

In this sense, the strategy defined by the European Commission and its partners through the creation and implementation of the Copernicus Program must constitute a global example of governance in this area regarding geospatial-based digitalization and sustainability achievement. By producing and providing highly valuable Earth-observation-based data and services on an open access and permanent basis and by fostering the creation and promotion of new highly disruptive and sustainable scientific, environmental, and socio-economic approaches, the Copernicus Program strongly contributes to a more cost-effective and flexible digitalization with more significant benefits for global sustainability.



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Digitizing healthy lifestyles

The promotion of health security and advancement is regarded as the nucleus of the UN's 2030 Agenda for Sustainable Development, which emphasizes the importance of resilient public health systems and governance. The recent pandemic has reinforced the necessity for healthy lifestyles and health literacy, leading an increasing number of citizens to healthy-eating mobile apps and wearable devices. The numerous reported benefits range from self-tracking behavior to social interactions affecting physical, social, and mental well-being. For instance, the use of wearables in healthy-eating education shows positive results in reducing anxiety. Overall, individuals, governments, and organizations are investing in digital technologies as signals of healthy lifestyles.

Healthy lifestyles are increasingly reflected by communicative media (such as numbers, sounds, and symbols) to indicate one's social, physical, and mental well-being, leading to digitized illustrations of self-worth and health standards. The norms of healthy lifestyles are translated to one's number of followers, closing three rings, achieving 10,000 steps, sleeping 8 h each night, eating five fruits and vegetables a day, or counting calories, implying that healthy lives can fit into numerical matrices and algorithms. Even though numbers have been guiding our health for centuries, a recent study funded by the British Academy Small Research Grants scheme indicates that digitizing healthy lifestyles could have some important implications for young people, including anxieties, negative self-image perceptions, and a numerical-focused approach to healthy living. There is a need for a better, more balanced approach in leading healthy lives.

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Collective knowledge for digital-led sustainability

There are at least three main reasons why more profound research on the nexus of digitalization and sustainability is deeply needed. First, digital tools and applications have the potential to facilitate transitions toward sustainable production and consumption patterns in various sectors. However, these solutions do not come automatically. There is a tremendous lack of knowledge regarding guiding principles, new policies, and new institutions for governing politics and other societal actors. Second, various digital applications run counter to sustainability goals in that they can be highly energy and resource intensive and bring unsustainable practices or impede sustainability-oriented innovations. Systemic knowledge on the environmental risks of digitalization is lacking, and policy solutions are needed to mitigate impacts. Third, even an environmentally oriented digitalization brings along challenges regarding privacy, information asymmetries, data security, fair public participation, the distribution of wealth, and other social aspects. Interdisciplinary knowledge that considers both social and environmental sustainability goals is needed. The project Digitalization for Sustainability – Science in Dialogue (D4S; http://www.digitalization-for-sustainability.com/) pursues a 2-year comprehensive dialogue to tackle these challenges. D4S has established an EU expert panel of 15 academics and practitioners from the technology, transformation, and sustainability communities. D4S aims to deliver comprehensive analyses on risks and opportunities, develop design principles and policies, and outline an inter- and transdisciplinary research agenda for the next decade.

Susanne Köhler and Massimo Pizzol
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Bitcoin: Energy intensive by design

The debate about Bitcoin's environmental impacts was stirred up again recently when new market price highs were reached, and Tesla first announced that it accepts Bitcoin for payments only to suspend them again because of concerns around the increasing use of fossil fuels for mining. In mid-May 2021, the Cambridge Centre for Alternative Finance estimated the energy consumption of Bitcoin to be above 140 TWh/year. This is >40% higher than that reported in January 2021 and 480% higher than that from late 2017, when concerns about Bitcoin's environmental impacts first reached the public.

Yet, determining Bitcoin's carbon footprint remains a challenge. Up-to-date data on miner locations and the types of energy and machines used are needed for making good estimations. However, much of the information about this system, such as the use of curtailed hydropower or the re-opening of power plants, remains anecdotal. Episodes such as the 35% hashrate drop after a coal mine in Xinjiang was flooded provide clues on the fossil fuel dependency, but scientists still rely on scarce information and detective work to build models for estimating Bitcoin's carbon footprint. Moreover, the dynamic and changing nature of this system is poorly understood, and it is difficult to make even short-term predictions.

To accurately assess the Bitcoin system and to clear speculations, we invite the Bitcoin mining industry to collaborate with scientists and to share data on mining locations and the types of energy and machines used. Furthermore, studies should focus on understanding the short-term dynamics and not fixate on making long-term predictions with little reliability.

Assessing the risks and benefits of digitalization

Digitalization is a complex dynamic process that has shaped our societies at a fundamental level. Digitalization should concern not only technological innovations but also social practices, such as the way we work or the way we engage with other people. The design openness and versatility of digital technologies imply that risks and benefits are not inherent properties of these technologies but rather the product of manifold interdependencies between technological innovations, economic drivers, societal and ecological impacts,

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and regulation. How do we assess these interdependencies, and how do we evaluate the risks and benefits of digitalization? The normative goal of sustainable development serves as a guiding principle for an evaluation of potential impacts. A systemic risk-benefit perspective provides an analytic approach for investigating the dynamics and interdependencies of digitalization, as well as reviewing the impacts. To promote sustainable development in the presence of risks, we need to evaluate the economic, ecological, and social impacts of digital technologies. Digital innovations can support sustainability objectives in ecological, economic, and social dimensions simultaneously. Although digital technologies provide the potential to foster these aims with design flexibility, they can reinforce path dependencies that lead to an increased use of resources. Given that opportunities and risks are intertwined, management decisions must rely on an inclusive and deliberative approach oriented toward sustainable development.

Dipti Srinivasan
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AI-enabled sustainable grids

Most parts of the developing and underdeveloped countries around the world have witnessed rising urbanization and unprecedented population growth in recent years. Increasing urbanization leads to growing energy demand, which creates pressing socio-environmental challenges given the current fossil-energy-dominated power systems. To shape sustainable cities, it is imperative to transform to a clean power system; however, the intermittent nature of renewable energy imposes barriers in providing reliable and secure electricity supply. The smart grid can be a solution. Artificial intelligence (AI) will play a pivotal role in making the grid smarter by analyzing the big data coming from millions of smart meters, renewable energy sources, and meteorological information to optimize resources and minimize harmful emissions. The large amounts of data can be efficiently processed by machine-learning algorithms given their demonstrated ability to handle big data and extract useful information. Hence, machine-learning algorithms, widespread connectivity, and information exchange will be vital for making a smart grid truly intelligent.

AI-based software will help city planners develop generative designs that holistically consider the interactions among energy, water, transportation, and environmental needs and provide unimaginable exciting opportunities. Future research on smart grids will focus primarily on AI-based software, plug-and-play technology, and grid automation. The conceptual frameworks are being developed and tested, and more research is necessary for addressing security problems such as physical threats and encryption and cybersecurity attacks.

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AI and climate change: Facilitating impactful deployment

AI and machine learning are a set of powerful computational tools that learn from patterns in data. Although no silver bullet, there are many ways that AI can potentially help address climate change through applications such as remote sensing, forecasting transportation demand, and targeting experiments for next-generation battery development. However, AI's utility in this area cannot be taken for granted, and the actual climate impact will rely on deploying it effectively and responsibly.

One fundamental prerequisite is that AI experts should not rely on the data alone—instead, they must collaborate with experts and deployment partners in climate-relevant areas such as energy, agriculture, and disaster response, as well as with other affected stakeholders. Such opportunities to collaborate across disciplines and sectors are rare, which is why we built an organization dedicated to the intersection of AI and climate change. Since its founding in 2019, Climate Change AI has turned into a central platform for convening a cross-disciplinary community and sharing expert knowledge in this rapidly evolving area. We now see a lot of enthusiasm among researchers and a growing need to apply these technologies in the real world. The next steps are to develop robust pathways for deployment, best practices, and capacity among a wide range of stakeholders. Moreover, the public and private sectors need tools to estimate where AI can be most beneficially used and where AI is really not needed or even counterproductive. Ultimately for AI to help with climate change, work needs to be designed with deployment in mind.