The Right to Be Simulated: Digital Twins and the Rise of Geo-Algorithmic Inequality

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Climate resilience strategies, investment flows, and urban development plans are increasingly shaped not by abstract forecasts, but by dynamic, real-time digital twins — living models of the real world. But while some regions are fully represented in these algorithmic futures, others remain data shadows. And in a world governed by models, to be unmodeled is to be unseen. Digital twins are not just interactive blueprints. They are full-scale simulations that mirror physical systems in real time using sensor data, machine learning, and AI. These twins can replicate cities, supply chains, ecosystems — even entire national economies — and simulate how they might respond to stress, investment, or policy change.

Siemens is building digital replicas of German rail systems to optimize maintenance and reduce emissions. NVIDIA's Omniverse powers industrial-scale simulations, while Microsoft and Palantir offer real-time digital twins for governments and logistics firms. These tools are not decorative — they are becoming interfaces of decision-making. Where to build, whom to insure, what to protect — increasingly, such questions are answered in the twin before they reach the real world. But not everyone makes it into the simulation. Germany's Siemens Mobility, the UK's National Digital Twin Programme, and Singapore's "Virtual Singapore" initiative are leading examples of national-scale modeling. These countries are simulating their futures — and influencing global decisions in the process.

By contrast, much of Africa, the Caribbean, and parts of Southeast Asia remain invisible in major digital twin ecosystems. Global climate simulations routinely lack granular data for these regions. That means decisions around infrastructure aid, disaster prevention, or carbon offsetting are made with incomplete information — or without them in mind at all. This emerging disparity has a name: geo-algorithmic inequality — the uneven inclusion of countries and communities in the simulations that shape global policy, investment, and resilience planning.

In the age of modeling, prediction is a form of power. Banks, insurers, ESG funds, and infrastructure consortia rely on digital simulations to assess risk and allocate capital. If a country or city isn't represented in the model, it risks being bypassed in strategic decisions — not because of malice, but because it simply doesn't exist in the frame of algorithmic analysis.

Digital twins are now influencing everything from port construction to energy transition plans to post-disaster recovery simulations. And increasingly, these decisions are automated, optimized — and rendered opaque to those left outside the simulation loop. This techno-economic invisibility compounds existing inequities. Without data infrastructure, nations remain locked out of predictive models. Without predictive models, they remain excluded from investment logic. And without investment, they lack the very infrastructure that would generate the data to be included in the first place. It's a feedback loop of exclusion.

Meanwhile, projects like Destination Earth in Europe — an ambitious initiative to create a full-scale digital replica of the planet — are accelerating the simulation race. But even as such efforts aim to aid climate adaptation and disaster planning, they risk encoding structural bias if access and data diversity are not guaranteed from the start. The danger is that absence becomes systemic: countries excluded from modeling today may become structurally invisible to global planning systems tomorrow. Their data will not be counted, their vulnerabilities will not be forecast, their

opportunities will not be priced in.

UNDP field experiments in Kosovo and Eurasia have shown that digital twins can be used for inclusive planning and sustainable urban development — but only when they are designed with equity in mind. As noted by UNEP and Thomson Reuters, cities are rapidly becoming central sites of environmental risk, and digital tools must capture the full spectrum of human and ecological complexity. If being seen is a prerequisite for inclusion in 21st-century planning, then being simulated must be recognized as a right. Global development frameworks must begin to treat algorithmic inclusion as part of digital rights — the same way we now discuss access to connectivity, data protection, or digital identity.

Contrary to the belief that digital twin technologies are the exclusive domain of wealthy governments or corporations, recent initiatives by the UNDP and UNDP Eurasia Innovation Team demonstrate their feasibility even in low-income contexts. In Kosovo, the UNDP piloted an open-access urban twin for Pristina using community mapping, satellite data, and open-source modeling tools to support sustainable planning and energy use. In Central Asia and the Western Balkans, digital twin simulations have been tested for climate resilience and infrastructure upgrades using cloud-based systems designed to work with minimal local data. These efforts show that simplified yet effective twin models can be co-developed with local actors to reflect regional needs—rather than imported as rigid, high-cost replicas of Western systems. As the Eurasia team notes, such tools can help policymakers “move from SimCity to real city” planning grounded in real-time data. The key challenge is ensuring these tools remain truly open, interoperable, and governed in partnership with the communities they simulate—otherwise they risk becoming new forms of digital dependency.

To ensure algorithmic fairness in global simulations, new policy frameworks are also emerging that could require developers and governments to disclose the “inclusion rate” of geographic, linguistic, and demographic diversity in their digital twins. Just as AI systems are now audited for representational bias, planetary-scale simulations and digital infrastructure twins should be held accountable for who and what they include—or omit. The European Commission’s Destination Earth initiative aims to simulate the entire planet’s systems, from water flows to urban emissions. However, without clear mandates for inclusion, such models risk reproducing the same global asymmetries found in other AI domains. A minimum threshold for inclusion—analogous to environmental impact assessments—could be required before deploying twins used for international policy, funding allocation, or infrastructure planning. Countries in the Global South, whose data is often missing or outdated, would benefit most from such a standard. An inclusion rate would not eliminate structural inequality, but it would make it visible—creating political pressure and legal pathways for redress. As AI systems increasingly shape how the world is planned, built, and governed, inclusion can no longer be a moral ideal. It must become a measurable requirement.

A critical step toward equitable simulation infrastructure lies in the governance of data itself. Europe’s Gaia-X initiative proposes a decentralized architecture for cloud and edge data sharing that respects national sovereignty, data ownership, and interoperability across borders. Although primarily developed for the EU, Gaia-X offers a template for other regions to avoid monopolistic control over simulation platforms. By requiring open standards and consent-based data exchange, it could serve as a foundation for internationally governed digital twins, especially in areas like climate adaptation and urban planning. If adopted beyond Europe—or emulated through regional partnerships in Latin America, Africa, or ASEAN—it could empower local actors to build and maintain simulation models on their own terms. This contrasts sharply with current trends where many digital twins are built on proprietary platforms controlled by tech giants like Siemens, Palantir, or NVIDIA, making public participation and oversight nearly impossible. A federated approach could allow multiple data stewards to participate in twin creation, verification, and use—ensuring that no single government or firm dictates the simulation of the future.

Digital twins are already proving their utility in environmental management, especially in water systems, which are highly vulnerable to climate change and poor infrastructure planning. A peer-reviewed study published in MDPI Water evaluated digital twin applications for water quality monitoring, flood prediction, and wastewater treatment—particularly in Southeast Asia and Eastern Europe. These systems allow governments to test policy responses in advance, optimize resource allocation, and prevent disasters through predictive modeling. For example, Singapore’s national “Virtual Twin” enables simulations of energy consumption, water use, and mobility patterns in

real time—forming a core part of its Smart Nation strategy. In the Global South, where climate-related crises disproportionately affect urban poor and rural communities, digital twins could significantly improve environmental planning—if made accessible. However, most existing deployments are proprietary or cost-prohibitive. Open environmental twins—co-developed with international institutions—can offer a practical entry point for countries to adopt these technologies without entering exploitative vendor lock-in or data extraction regimes. Water may be the first domain where inclusive twins prove not just possible—but essential.

Digital twins are not neutral tools. They reflect choices about what matters, who is counted, and which futures are deemed plausible. And as these simulations increasingly guide global policy, investment, and adaptation, the stakes are no longer technical — they are existential. In an age shaped by simulation, visibility itself has become a form of survival. The next great divide may not be digital — but simulated.

About the author:

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