



Scenarios for the Future of Technology and International Development

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Letter from Judith Rodin

President of the Rockefeller Foundation

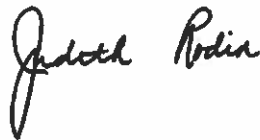
The Rockefeller Foundation supports work that expands opportunity and strengthens resilience to social, economic, health, and environmental challenges – affirming its pioneering philanthropic mission, since 1913, to “promote the well-being” of humanity. We take a synergistic, strategic approach that places a high value on innovative processes and encourages new ways of seeking ideas, to break down silos and encourage interdisciplinary thinking.

One important – and novel – component of our strategy toolkit is scenario planning, a process of creating narratives about the future based on factors likely to affect a particular set of challenges and opportunities. We believe that scenario planning has great potential for use in philanthropy to identify unique interventions, simulate and rehearse important decisions that could have profound implications, and highlight previously undiscovered areas of connection and intersection. Most important, by providing a methodological structure that helps us focus on what we don't know – instead of what we already know – scenario planning allows us to achieve impact more effectively.

The results of our first scenario planning exercise demonstrate a provocative and engaging exploration of the role of technology and the future of globalization, as you will see in the following pages. This report is crucial reading for anyone interested in creatively considering the multiple, divergent ways in which our world could evolve. The sparks of insight inspiring these narratives – along with their implications for philanthropy as a whole – were generated through the invaluable collaboration of grantee representatives, external experts, and Rockefeller Foundation staff. I offer a special thanks to Peter Schwartz, Andrew Blau, and the entire team at Global Business Network, who have helped guide us through this stimulating and energizing process.

Leading this effort at the Rockefeller Foundation is our Research Unit, which analyzes emerging risks and opportunities and thinks imaginatively about how to respond to the complex, rapidly changing world around us. This outward-looking intelligence function adopts a cross-cutting mindset that synthesizes and integrates knowledge that accelerates our ability to act more quickly and effectively. It has also helped to shape and build the notion of “pro-poor foresight” that is committed to applying forward-looking tools and techniques to improve the lives of poor and vulnerable populations around the world.

I hope this publication makes clear exactly why my colleagues and I are so excited about the promise of using scenario planning to develop robust strategies and offer a refreshing viewpoint on the possibilities that lie ahead. We welcome your feedback.



Judith Rodin
President
The Rockefeller Foundation

Letter from Peter Schwartz

Cofounder and Chairman of Global Business Network

We are at a moment in history that is full of opportunity. Technology is poised to transform the lives of millions of people throughout the world, especially those who have had little or no access to the tools that can deliver sustainable improvements for their families and communities. From farmers using mobile phones to buy and sell crops to doctors remotely monitoring and treating influenza outbreaks in rural villages, technology is rapidly becoming more and more integral to the pace and progress of development.

Philanthropy has a unique and critical role to play in this process. By focusing its patience, capital, and attention on the links between technology and international development, philanthropy will change not just lives but the very context in which the field of philanthropy operates. This report represents an initial step in that direction. It explores four very different—yet very possible—scenarios for the future of technology and development in order to illuminate the challenges and opportunities that may lie ahead. It promotes a deeper understanding of the complex forces and dynamics that will accelerate or inhibit the use of technology to spur growth, opportunity, and resilience especially in the developing world. Finally, it will seed a new strategic conversation among the key public, private, and philanthropic stakeholders about technology and development at the policy, program, and human levels.

The Rockefeller Foundation's use of scenario planning to explore technology and international development has been both inspired and ambitious. Throughout my 40-plus-year career as a scenario planner, I have worked with many of the world's leading companies, governments, foundations, and nonprofits—and I know firsthand the power of the approach. Scenario planning is a powerful tool precisely because the future is unpredictable and shaped by many interacting variables. Scenarios enable us to think creatively and rigorously about the different ways these forces may interact, while forcing us to challenge our own assumptions about what we

believe or hope the future will be. Scenarios embrace and weave together multiple perspectives and provide an ongoing framework for spotting and making sense of important changes as they emerge. Perhaps most importantly, scenarios give us a new, shared language that deepens our conversations about the future and how we can help to shape it.

The Rockefeller Foundation has already used this project as an opportunity to clarify and advance the relationship between technology and development. Through interviews and the scenario workshops, they have engaged a diverse set of people—from different geographies, disciplines, and sectors—to identify the key forces driving change, to explore the most critical uncertainties, and to develop challenging yet plausible scenarios and implications. They have stretched their thinking far beyond theoretical models of technology innovation and diffusion in order to imagine how technology could actually change the lives of people from many walks of life. This is only the start of an important conversation that will continue to shape the potential of technology and international development going forward. I look forward to staying a part of that conversation and to the better future it will bring.



Peter Schwartz
Cofounder and Chairman
Global Business Network

Introduction

For decades, technology has been dramatically changing not just the lives of individuals in developed countries, but increasingly the lives and livelihoods of people throughout the developing world. Whether it is a community mobile phone, a solar panel, a new farming practice, or a cutting-edge medical device, technology is altering the landscape of possibility in places where possibilities used to be scarce.

And yet looking out to the future, there is no single story to be told about how technology will continue to help shape—or even revolutionize—life in developing countries. There are many possibilities, some good and some less so, some known and some unknowable. Indeed, for everything we think we can anticipate about how technology and international development will interact and intertwine in the next 20 years and beyond, there is so much more that we cannot yet even imagine.

For philanthropies as well as for other organizations, this presents a unique challenge: given the uncertainty about how the future will play out, how can we best position ourselves not just to identify technologies that improve the

lives of poor communities but also to help scale and spread those that emerge? And how will the social, technological, economic, environmental, and political conditions of the future enable or inhibit our ability to do so?

The Rockefeller Foundation believes that in order to understand the many ways in which technology will impact international development in the future, we must first broaden and deepen our individual and collective understanding of the range of possibilities. This report, and the project upon which it is based, is one attempt to do that. In it, we share the outputs and insights from a year-long project, undertaken by the Rockefeller Foundation and Global Business Network (GBN), designed to

explore the role of technology in international development through scenario planning, a methodology in which GBN is a long-time leader.

This report builds on the Rockefeller Foundation's growing body of work in the emerging field of pro-poor foresight. In 2009, the Institute for Alternative Futures published the report *Foresight for Smart Globalization: Accelerating and Enhancing Pro-Poor Development Opportunities*, with support from the Rockefeller Foundation. That effort was a reflection of the Foundation's strong commitment to exploring innovative processes and embracing new pathways for insight aimed at helping the world's poor. With this report, the Foundation takes a further step in advancing the field of pro-poor foresight, this time through the lens of scenario planning.

WHY SCENARIOS?

The goal of this project was not to affirm what is already known and knowable about what is happening right now at the intersections of technology and development. Rather, it was to explore the many ways in which technology and development could co-evolve—could both push and inhibit each other—in the future, and

then to begin to examine what those possible alternative paths may imply for the world's poor and vulnerable populations. Such an exercise required project participants to push their thinking far beyond the status quo, into uncharted territory.

Scenario planning is a methodology designed to help guide groups and individuals through exactly this creative process. The process begins by identifying forces of change in the world, then combining those forces in different ways to create a set of diverse stories—or scenarios—about how the future could evolve. Scenarios are designed to stretch our thinking about both the opportunities and obstacles that the future might hold; they explore, through narrative, events and dynamics that might alter, inhibit, or enhance current trends, often in surprising ways. Together, a set of scenarios captures a range of future possibilities, good and bad, expected and surprising—but always plausible. Importantly, scenarios are not predictions. Rather, they are thoughtful hypotheses that allow us to imagine, and then to rehearse, different strategies for how to be more prepared for the future—or more ambitiously, how to help shape better futures ourselves.



WHY TECHNOLOGY?

Technology was chosen as a focal point of this project because of its potentially transformative role—both in a positive and negative way—in addressing a wide range of development challenges, from climate change, healthcare, and agriculture to housing, transportation, and education. Yet while there is little doubt that technology will continue to be a driver of change across the developing world in the future, the precise trajectory along which technological innovation will travel is highly uncertain. For example, will critical technological advances come from the developed world, or will innovators and their innovations be more geographically dispersed? Or, how might the global economic and political environment affect the pace of technology development?

It is important to state that in focusing on technology, this project did not set out to identify a set of exact, yet-to-be-invented technologies that will help shape and change the future. Rather, the goal was to gain a broader and richer understanding of different paths along which technology could develop—paths that will be strongly influenced by the overall global environment in which the inventors and adopters of those technologies will find themselves working and dwelling. Technology,

as a category, cannot be divorced from the context in which it develops. The scenarios shared in this report explore four such contexts, each of which, as you'll see, suggests very different landscapes for technology and its potential impacts in the developing world.

Finally, a note about what we mean by “technology.” In this report, we use the term to refer to a broad spectrum of tools and methods of organization. Technologies can range from tools for basic survival, such as a treadle pump and basic filtration technologies, to more advanced innovations, such as methods of collecting and utilizing data in health informatics and novel building materials with real-time environmental sensing capabilities. This report focuses on themes associated with the widespread scalability, adoption, and assessment of technology in the developing world. While the scenarios themselves are narratives about the global environment, we have paid particular attention to how events might transpire in sub-Saharan Africa, Southeast Asia, and India.

THE FOCAL QUESTION

Every scenario project has a focal question – a broad yet strategic query that serves as an anchor for the scenarios. For this project, the focal question was:

How might technology affect barriers to building resilience and equitable growth in the developing world over the next 15 to 20 years?

In other words, what new or existing technologies could be leveraged to improve the capacity of individuals, communities, and systems to respond to major changes, or what technologies could improve the lives of vulnerable populations around the world? A 15- to 20-year timeframe was chosen on the assumption that it is both sufficiently long

A Note on Terminology

The Foundation's work promotes "resilience and equitable growth." Resilience refers to the capacity of individuals, communities, and systems to survive, adapt, and grow in the face of changes, even catastrophic incidents. Equitable growth involves enabling individuals, communities, and institutions to access new tools, practices, resources, services, and products.

enough that significant technological change is plausible and sufficiently short enough that we can imagine some possibilities for the kinds of technologies that could be developed and applied. Focusing on how to overcome a set of obstacles associated with the application of technology to the challenges of development helped to both bound the inquiry and promote a problem-solving approach that seeks to identify potential, systematic intervention opportunities.

ENGAGING YOUR IMAGINATION

It is our hope that these scenarios help inspire the same future-orientation in other initiatives that are broadly concerned with technology and international development. Of course, there is no hard data about the future – nobody yet knows precisely what technologies will be successful at addressing new and evolving development needs. Rather, as you read the scenarios, think of them as a journey – four journeys – into a future that is relevant, thought-provoking, and possible. Imagine how the world will function and how it will be organized to tackle the challenges it faces. Who will be responsible for driving local and global development initiatives and what would that require? And what is your own role in leading your organization, community, or region to a preferred future?

Scenarios are a medium through which great change can be not just envisioned but also actualized. The more closely you read them, the more likely it becomes that you will recognize their important but less obvious implications to you, your work, and your community. We strongly encourage you to share and discuss this report widely, use it as a springboard for further creative thinking about how technology

could shape development, and test and adjust your strategies or personal actions accordingly.

It is also our hope that these scenarios help to identify potential areas of future work for governments, philanthropies, corporations, and nonprofits, and that they illuminate choices and commitments that a wide range of organizations may want to make in these areas in the future.

FURTHER READING ON TECHNOLOGY AND DEVELOPMENT

This report adds to a growing body of literature focusing on the relationship between technology, development, and social systems. While not a comprehensive list, the following readings offer additional insights on this topic.

- Caroline Wagner, *The New Invisible College: Science for Development*, 2008.
- Institute for the Future, *Science and Technology Outlook: 2005-2055*, 2006.
- RAND Corporation, *The Global Technology Revolution 2020, In-Depth Analyses*, 2006.
- World Bank, *Science, Technology, and Innovation: Capacity Building for Sustainable Growth and Poverty Reduction*, 2008.
- UN Millennium Project, Task Force on Science, Technology, and Innovation, *Innovation: Applying Knowledge in Development*, 2006.
- W. Brian Arthur, *The Nature of Technology: What It Is and How It Evolves*, 2009.
- STEPS Centre Working Papers, *Innovation, Sustainability, Development: A New Manifesto*, 2009.

The Scenario Framework

The Rockefeller Foundation and GBN began the scenario process by surfacing a host of driving forces that would affect the future of technology and international development. These forces were generated through both secondary research and in-depth interviews with Foundation staff, Foundation grantees, and external experts.

Next, all these constituents came together in several exploratory workshops to further brainstorm the content of these forces, which could be divided into two categories: predetermined elements and critical uncertainties. A good starting point for any set of scenarios is to understand those driving forces that we can be reasonably certain will shape the worlds we are describing, also known as “predetermined elements.” For example, it is a near geopolitical certainty that—with the rise of China, India, and other nations—a multi-polar global system is emerging. One demographic certainty is that global population growth will continue and will put pressure on energy, food, and water resources—especially in the developing world. Another related certainty: that the world will strive to source more of its energy

from renewable resources and may succeed, but there will likely still be a significant level of global interdependence on energy.

Predetermined elements are important to any scenario story, but they are not the foundation on which these stories are built. Rather, scenarios are formed around “critical uncertainties”—driving forces that are considered both highly important to the focal issue and highly uncertain in terms of their future resolution. Whereas predetermined elements are predictable driving forces, uncertainties are by their nature unpredictable: their outcome can be guessed at but not known.

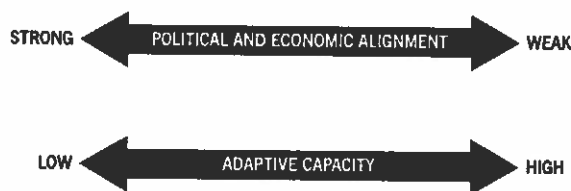
While any single uncertainty could challenge our thinking, the future will be shaped by multiple forces playing out over time. The scenario framework provides a structured way to consider how these critical uncertainties might unfold and evolve in combination. Identifying the two most important uncertainties guarantees that the resulting scenarios will differ in ways that have been judged to be critical to the focal question.

CHOOSING THE CRITICAL UNCERTAINTIES

During this project’s scenario creation workshop, participants – who represented a range of regional and international perspectives – selected the two critical uncertainties that would form the basis of the scenario framework. They chose these two uncertainties from a longer list of potential uncertainties that might shape the broader contextual environment of the scenarios, including social, technology, economic, environmental, and political trends. The uncertainties that were considered included,

for example, the pervasiveness of conflict in the developing world; the frequency and severity of shocks like economic and political crises, disease, and natural disasters; and the locus of innovation for crucial technologies for development. (A full list of the critical uncertainties identified during the project, as well as a list of project participants, can be found in the Appendix.)

The two chosen uncertainties, introduced below, together define a set of four scenarios for the future of technology and international development that are divergent, challenging, internally consistent, and plausible. Each of the two uncertainties is expressed as an axis that represents a continuum of possibilities ranging between two endpoints.



GLOBAL POLITICAL AND ECONOMIC ALIGNMENT

This uncertainty refers to both the amount of economic integration—the flow of goods, capital, people, and ideas—as well as the extent to which enduring and effective political structures enable the world to deal with many of the global challenges it faces. On one end of the axis, we would see a more integrated global economy with high trade volumes, which enables access to a wider range of goods and services through imports and exports, and the increasing specialization of exports. We would also see more cooperation at the supra-national level, fostering increased collaboration, strengthened global institutions, and the formation of effective international problem-solving networks. At the other axis endpoint, the potential for economic development in the developing world would be reduced by the fragility of the overall global economy—coupled with protectionism and fragmentation of trade—along with a weakening of governance regimes that raise barriers to cooperation, thereby hindering agreement on and implementation of large-scale, interconnected solutions to pressing global challenges.

ADAPTIVE CAPACITY

This uncertainty refers to the capacity at different levels of society to cope with change and to adapt effectively. This ability to adapt can mean proactively managing existing systems and structures to ensure their resilience against external forces, as well as the ability to transform those systems and structures when a changed context means they are no longer suitable. Adaptive capacity is generally associated with higher levels of education in a society, as well as the availability of outlets for those who have educations to further their individual and societal well-being. High levels of adaptive capacity are typically achieved through the existence of trust in society; the presence and tolerance of novelty and diversity; the strength, variety, and overlap of human institutions; and the free flow of communication and ideas, especially between and across different levels, e.g., bottom-up and top-down. Lower levels of adaptive capacity emerge in the absence of these characteristics and leave populations particularly vulnerable to the disruptive effects of unanticipated shocks.

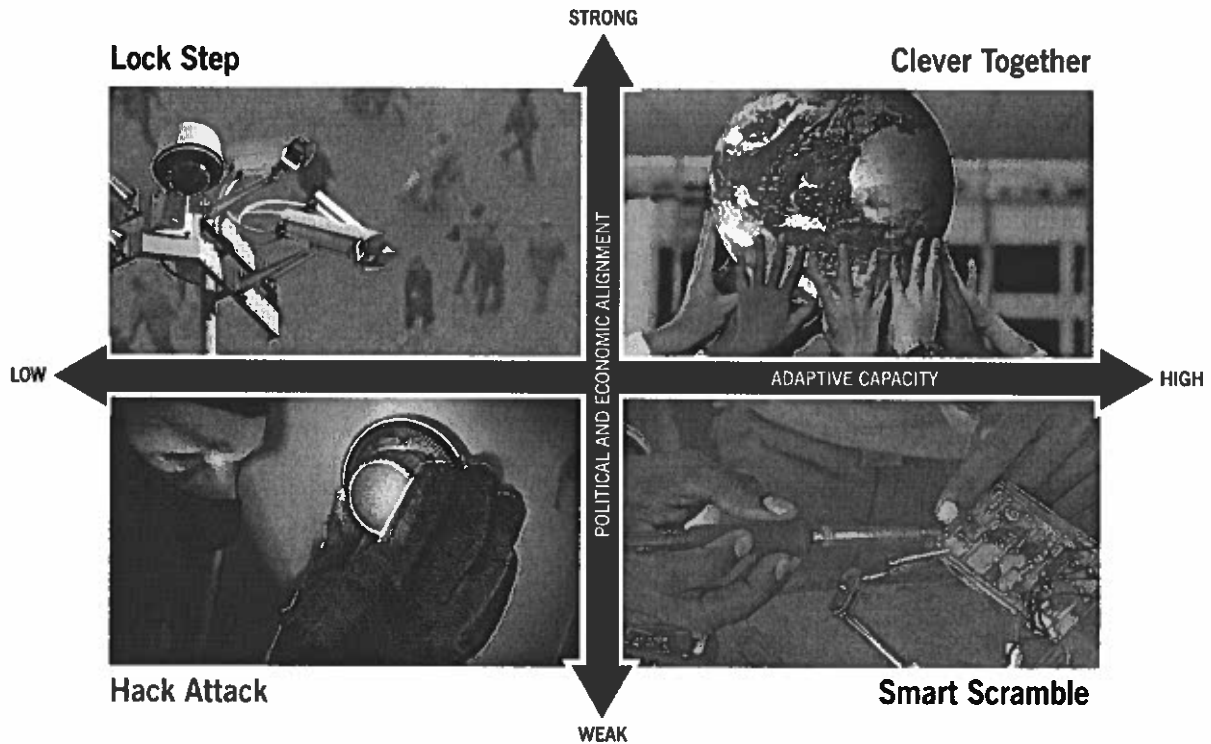
Once crossed, these axes create a matrix of four very different futures:

LOCK STEP – A world of tighter top-down government control and more authoritarian leadership, with limited innovation and growing citizen pushback

CLEVER TOGETHER – A world in which highly coordinated and successful strategies emerge for addressing both urgent and entrenched worldwide issues

HACK ATTACK – An economically unstable and shock-prone world in which governments weaken, criminals thrive, and dangerous innovations emerge

SMART SCRAMBLE – An economically depressed world in which individuals and communities develop localized, makeshift solutions to a growing set of problems



THE SCENARIO NARRATIVES

The scenarios that follow are not meant to be exhaustive – rather, they are designed to be both plausible and provocative, to engage your imagination while also raising new questions for you about what that future might look and feel like. Each scenario tells a story of how the world, and in particular the developing world, might progress over the next 15 to 20 years, with an emphasis on those elements relating to the use of different technologies and the interaction of these technologies with the lives of the poor and vulnerable. Accompanying each scenario is a range of elements that aspire to further illuminate life, technology, and philanthropy in that world. These include:

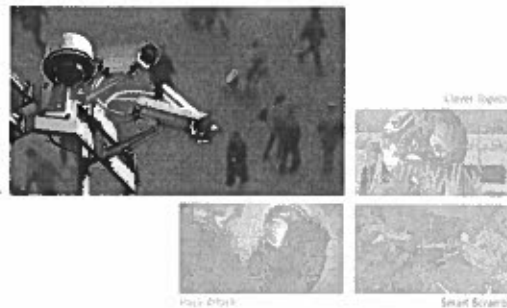
- A timeline of possible headlines and emblematic events unfolding during the period of the scenario
- Short descriptions of what technologies and technology trends we might see
- Initial observations on the changing role of philanthropy in that world, highlighting opportunities and challenges that philanthropic organizations would face and what their operating environment might be like
- A “day in the life” sketch of a person living and working in that world

Please keep in mind that the scenarios in this report are stories, not forecasts, and the plausibility of a scenario does not hinge on the occurrence of any particular detail. In the scenario titled “Clever Together,” for example, “a consortium of nations, NGOs [non-governmental organizations], and companies establish the Global Technology Assessment Office” – a detail meant to symbolize how a high degree of international coordination and adaptation might lead to the formation of a body that anticipates technology’s potential societal implications. That detail, along with dozens of others in each scenario, is there to give you a more tangible “feel” for the world described in the scenario. Please consider names, dates, and other such specifics in each scenario as proxies for types of events, not as necessary conditions for any particular scenario to unfold.

We now invite you to immerse yourself in each future world and consider four different visions for the evolution of technology and international development to 2030.

Scenario Narratives

Lock Step



LOCK STEP

A world of tighter top-down government control and more authoritarian leadership, with limited innovation and growing citizen pushback

In 2012, the pandemic that the world had been anticipating for years finally hit. Unlike 2009's H1N1, this new influenza strain—originating from wild geese—was extremely virulent and deadly. Even the most pandemic-prepared nations were quickly overwhelmed when the virus streaked around the world, infecting nearly 20 percent of the global population and killing 8 million in just seven months, the majority of them healthy young adults. The pandemic also had a deadly effect on economies: international mobility of both people and goods screeched to a halt, debilitating industries like tourism and breaking global supply chains. Even locally, normally bustling shops and office buildings sat empty for months, devoid of both employees and customers.

The pandemic blanketed the planet—though disproportionate numbers died in Africa, Southeast Asia, and Central America, where the virus spread like wildfire in the absence of official containment protocols. But even in developed countries, containment was a challenge. The United States's initial policy of "strongly discouraging" citizens from flying proved deadly in its leniency, accelerating the spread of the virus not just within the U.S. but across borders. However, a few countries did fare better—China in particular. The Chinese government's quick imposition and enforcement of mandatory quarantine for all citizens, as well as its instant and near-hermetic sealing off of all borders, saved millions of lives, stopping the spread of the virus far earlier than in other countries and enabling a swifter post-pandemic recovery.



China's government was not the only one that took extreme measures to protect its citizens from risk and exposure. During the pandemic, national leaders around the world flexed their authority and imposed airtight rules and restrictions, from the mandatory wearing of face masks to body-temperature checks at the entries to communal spaces like train stations and supermarkets. Even after the pandemic faded, this more authoritarian control and oversight of citizens and their activities stuck and even intensified. In order to protect themselves from the spread of increasingly global problems—from pandemics and transnational terrorism to environmental crises and rising poverty—leaders around the world took a firmer grip on power.

At first, the notion of a more controlled world gained wide acceptance and approval. Citizens willingly gave up some of their sovereignty—and their privacy—to more paternalistic states in exchange for greater safety and stability. Citizens were more tolerant, and even eager, for top-down direction and oversight, and national leaders had more latitude to impose order in the ways they saw fit. In developed countries, this heightened oversight took many forms: biometric IDs for all citizens, for example, and tighter regulation of key industries whose stability

was deemed vital to national interests. In many developed countries, enforced cooperation with a suite of new regulations and agreements slowly but steadily restored both order and, importantly, economic growth.

Across the developing world, however, the story was different—and much more variable. Top-down authority took different forms in different countries, hinging largely on the capacity, caliber, and intentions of their leaders. In countries with strong and thoughtful leaders, citizens' overall economic status and quality of life increased. In India, for example, air quality drastically improved after 2016, when the government outlawed high-emitting vehicles. In Ghana, the introduction of ambitious government programs to improve basic infrastructure and ensure the availability of clean water for all her people led to a sharp decline in water-borne diseases. But more authoritarian leadership worked less well—and in some cases tragically—in countries run by irresponsible elites who used their increased power to pursue their own interests at the expense of their citizens.

There were other downsides, as the rise of virulent nationalism created new hazards: spectators at the 2018 World Cup, for example,





wore bulletproof vests that sported a patch of their national flag. Strong technology regulations stifled innovation, kept costs high, and curbed adoption. In the developing world, access to “approved” technologies increased but beyond that remained limited: the locus of technology innovation was largely in the developed world, leaving many developing countries on the receiving end of technologies that others consider “best” for them. Some

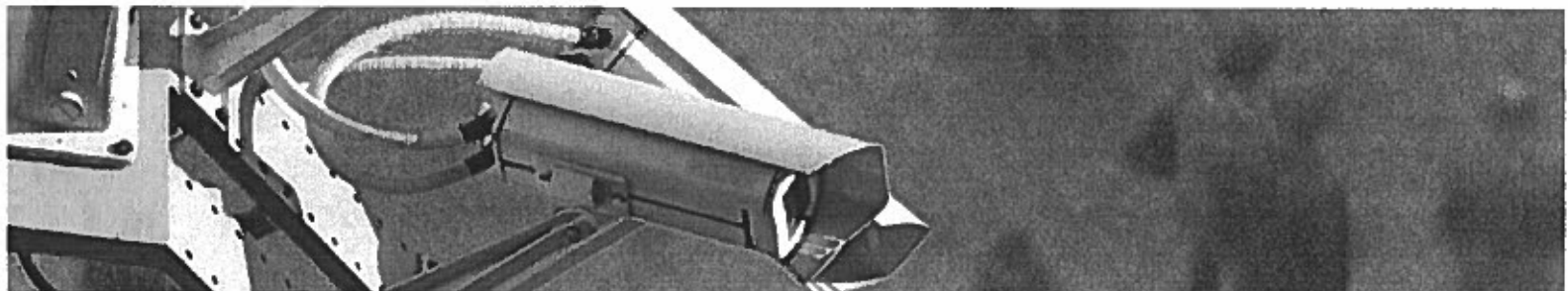
“IT IS POSSIBLE TO DISCIPLINE AND CONTROL SOME SOCIETIES FOR SOME TIME, BUT NOT THE WHOLE WORLD ALL THE TIME.”

– GK Bhat, TARU Leading Edge, India

governments found this patronizing and refused to distribute computers and other technologies that they scoffed at as “second hand.” Meanwhile, developing countries with more resources and better capacity began to innovate internally to fill these gaps on their own.

Meanwhile, in the developed world, the presence of so many top-down rules and norms greatly inhibited entrepreneurial activity. Scientists and innovators were often told by governments what research lines to pursue and were guided mostly toward projects that would make money (e.g., market-driven product development) or were “sure bets” (e.g., fundamental research), leaving more risky or innovative research areas largely untapped. Well-off countries and monopolistic companies with big research and development budgets still made significant advances, but the IP behind their breakthroughs remained locked behind strict national or corporate protection. Russia and India imposed stringent domestic standards for supervising and certifying encryption-related products and their suppliers—a category that in reality meant all IT innovations. The U.S. and EU struck back with retaliatory national standards, throwing a wrench in the development and diffusion of technology globally.

Especially in the developing world, acting in one’s national self-interest often meant seeking practical alliances that fit with those





interests – whether it was gaining access to needed resources or banding together in order to achieve economic growth. In South America and Africa, regional and sub-regional alliances became more structured. Kenya doubled its trade with southern and eastern Africa, as new partnerships grew within the continent. China's investment in Africa expanded as the bargain of new jobs and infrastructure in exchange for access to key minerals or food exports proved agreeable to many governments. Cross-border ties proliferated in the form of official security aid. While the deployment of foreign security teams was welcomed in some of the most dire failed states, one-size-fits-all solutions yielded few positive results.

By 2025, people seemed to be growing weary of so much top-down control and letting leaders and authorities make choices for them.

Wherever national interests clashed with individual interests, there was conflict. Sporadic pushback became increasingly organized and coordinated, as disaffected youth and people who had seen their status and opportunities slip away – largely in developing countries – incited civil unrest. In 2026, protestors in Nigeria brought down the government, fed up with the entrenched cronyism and corruption. Even those who liked the greater stability and predictability of this world began to grow uncomfortable and constrained by so many tight rules and by the strictness of national boundaries. The feeling lingered that sooner or later, something would inevitably upset the neat order that the world's governments had worked so hard to establish. •



HEADLINES IN LOCK STEP



ROLE OF PHILANTHROPY IN LOCK STEP

Philanthropic organizations will face hard choices in this world. Given the strong role of governments, doing philanthropy will require heightened diplomacy skills and the ability to operate effectively in extremely divergent environments. Philanthropy grantee and civil society relationships will be strongly moderated by government, and some foundations might choose to align themselves more closely with national official development assistance (ODA) strategies and government objectives. Larger philanthropies will retain an outsized share of influence, and many smaller philanthropies may find value in merging financial, human, and operational resources.

Philanthropic organizations interested in promoting universal rights and freedoms will get blocked at many nations' borders. Developing smart, flexible, and wide-ranging relationships in this world will be key; some philanthropies may choose to work only in places where their skills and services don't meet resistance. Many governments will place severe restrictions on the program areas and geographies that international philanthropies can work in, leading to a narrower and stronger geographic focus or grant-making in their home country only.



TECHNOLOGY IN LOCK STEP

While there is no way of accurately predicting what the important technological advancements will be in the future, the scenario narratives point to areas where conditions may enable or accelerate the development of certain kinds of technologies. Thus for each scenario we offer a sense of the context for technological innovation, taking into consideration the pace, geography, and key creators. We also suggest a few technology trends and applications that could flourish in each scenario.

Technological innovation in “Lock Step” is largely driven by government and is focused on issues of national security and health and safety. Most technological improvements are created by and for developed countries, shaped by governments’ dual desire to control and to monitor their citizens. In states with poor governance, large-scale projects that fail to progress abound.

Technology trends and applications we might see:

- Scanners using advanced functional magnetic resonance imaging (fMRI) technology become the norm at airports and other public areas to detect abnormal behavior that may indicate “antisocial intent.”
- In the aftermath of pandemic scares, smarter packaging for food and beverages is applied first by big companies and producers in a business-to-business environment, and then adopted for individual products and consumers.
- New diagnostics are developed to detect communicable diseases. The application of health screening also changes; screening becomes a prerequisite for release from a hospital or prison, successfully slowing the spread of many diseases.
- Tele-presence technologies respond to the demand for less expensive, lower-bandwidth, sophisticated communications systems for populations whose travel is restricted.
- Driven by protectionism and national security concerns, nations create their own independent, regionally defined IT networks, mimicking China’s firewalls. Governments have varying degrees of success in policing internet traffic, but these efforts nevertheless fracture the “World Wide” Web.



LIFE IN LOCK STEP

Manisha gazed out on the Ganges River, mesmerized by what she saw. Back in 2010, when she was 12 years old, her parents had brought her to this river so that she could bathe in its holy waters. But standing at the edge, Manisha had been afraid. It wasn't the depth of the river or its currents that had scared her, but the water itself: it was murky and brown and smelled pungently of trash and dead things. Manisha had balked, but her mother had pushed her forward, shouting that this river flowed from the lotus feet of Vishnu and she should be honored to enter it. Along with millions of Hindus, her mother believed the Ganges's water could cleanse a person's soul of all sins and even cure the sick. So Manisha had grudgingly dunked herself in the river, accidentally swallowing water in the process and receiving a bad case of giardia, and months of diarrhea, as a result.

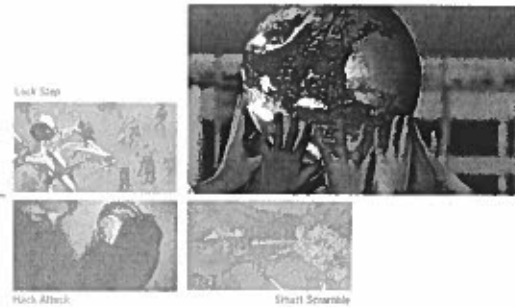
Remembering that experience is what made today so remarkable. It was now 2025. Manisha was 27 years old and a manager for the Indian government's Ganges Purification Initiative (GPI). Until recently, the Ganges was still one of the most polluted rivers in the world, its coliform bacteria levels astronomical due to the frequent disposal of human and animal corpses and of sewage (back in 2010, 89 million liters *per day*) directly into the river. Dozens of organized attempts to clean the Ganges over the years had failed. In 2009, the World Bank even loaned India \$1 billion to support the government's multi-billion dollar cleanup initiative. But then the pandemic hit, and that funding dried up. But what didn't dry up was the government's commitment to cleaning the Ganges – now not just an issue of public health but increasingly one of national pride.

Manisha had joined the GPI in 2020, in part because she was so impressed by the government's strong stance on restoring the ecological health of India's most treasured resource. Many lives in her home city of Jaipur had been saved by the government's quarantines during the pandemic, and that experience, thought Manisha, had given the government the confidence to be so strict about river usage



now: how else could they get millions of Indian citizens to completely shift their cultural practices in relationship to a holy site? Discarding ritually burned bodies in the Ganges was now illegal, punishable by years of jail time. Companies found to be dumping waste of any kind in the river were immediately shut down by the government. There were also severe restrictions on where people could bathe and where they could wash clothing. Every 20 meters along the river was marked by a sign outlining the repercussions of “disrespecting India’s most treasured natural resource.” Of course, not everyone liked it; protests flared every so often. But no one could deny that the Ganges was looking more beautiful and healthier than ever.

Manisha watched as an engineering team began unloading equipment on the banks. Many top Indian scientists and engineers had been recruited by the government to develop tools and strategies for cleaning the Ganges in more high-tech ways. Her favorite were the submersible bots that continuously “swam” the river to detect, through sensors, the presence of chemical pathogens. New riverside filtration systems that sucked in dirty river water and spit out far cleaner water were also impressive—especially because on the outside they were designed to look like mini-temples. In fact, that’s why Manisha was at the river today, to oversee the installation of a filtration system located not even 100 feet from where she first stepped into the Ganges as a girl. The water looked so much cleaner now, and recent tests suggested that it might even meet drinkability standards by 2035. Manisha was tempted to kick off her shoe and dip her toe in, but this was a restricted area now—and she, of all people, would never break that law.



CLEVER TOGETHER

A world in which highly coordinated and successful strategies emerge for addressing both urgent and entrenched worldwide issues

The recession of 2008–10 did not turn into the decades-long global economic slide that many had feared. In fact, quite the opposite: strong global growth returned in force, with the world headed once again toward the demographic and economic projections forecasted before the downturn. India and China were on track to see their middle classes explode to 1 billion by 2020. Mega-cities like Sao Paulo and Jakarta expanded at a blistering pace as millions poured in from rural areas. Countries raced to industrialize by whatever means necessary; the global marketplace bustled.

But two big problems loomed. First, not all people and places benefited equally from this return to globalized growth: all boats were rising, but some were clearly rising more. Second, those hell-bent on development

and expansion largely ignored the very real environmental consequences of their unrestricted growth. Undeniably, the planet's climate was becoming increasingly unstable. Sea levels were rising fast, even as countries continued to build-out coastal mega-cities. In 2014, the Hudson River overflowed into New York City during a storm surge, turning the World Trade Center site into a three-foot-deep lake. The image of motorboats navigating through lower Manhattan jarred the world's most powerful nations into realizing that climate change was not just a developing-world problem. That same year, new measurements showing that atmospheric carbon dioxide levels were climbing precipitously created new urgency and pressure for governments (really, for everyone) to do something fast.



In such an interconnected world, where the behaviors of one country, company, or individual had potentially high-impact effects on all others, piecemeal attempts by one nation here, one small collective of environmental organizations there, would not be enough to stave off a climate disaster—or, for that matter, to effectively address a host of other planetary-scale problems. But highly coordinated worldwide strategies for addressing such urgent issues just might. What was needed was systems thinking—and systems acting—on a global scale.

International coordination started slowly, then accelerated faster than anyone had imagined. In 2015, a critical mass of middle income and developed countries with strong economic growth publicly committed to leveraging their resources against global-scale problems, beginning with climate change. Together, their governments hashed out plans for monitoring and reducing greenhouse gas emissions in the short term and improving the absorptive capacity of the natural environment over the long term. In 2017, an international agreement was reached on carbon sequestration (by then, most multinational corporations had a chief carbon officer) and intellectual and financial resources were pooled to build out carbon

capture processes that would best support the global ecosystem. A functioning global cap and trade system was also established. Worldwide, the pressure to reduce waste and increase efficiency in planet-friendly ways was enormous. New globally coordinated systems for monitoring energy use capacity—including smart grids and bottom-up pattern recognition technologies—were rolled out. These efforts produced real results: by 2022, new projections showed a significant slowing in the rise of atmospheric carbon levels.

Inspired by the success of this experiment in collective global action, large-scale coordinated initiatives intensified. Centralized global oversight and governance structures sprang up, not just for energy use but also for disease and technology standards. Such systems and structures required far greater levels of transparency, which in turn required more tech-enabled data collection, processing, and feedback. Enormous, benign “sousveillance” systems allowed citizens to access data—all publically available—in real time and react. Nation-states lost some of their power and importance as global architecture strengthened and regional governance structures emerged. International oversight entities like the UN

