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[Â The Rockefeller Foundation Scenarios for the Future of Technology and International Development 2010](#)



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

**Rockefeller Plan to Use Bioweapons
to Impose Martial Law One Quarantine at a Time**

EXCERPTS - BELOW

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

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

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 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.

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.

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.

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.

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

Each scenario tells a story of how the world, and in particular the developing world, might progress over the next 15 to 20 years.

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.

Rockefeller Plan to Use Bioweapons to Impose Martial Law One Quarantine at a Time.

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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.

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.

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. *

"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

Scenario Narratives LOCK STEP HEADLINES IN LOCK STEP
Quarantine Restricts In-Person Contact; Cellular Networks Overloaded (2013)

Vietnam to Require 'A Solar Panel on Every Home' (2022)

African Leaders Fear Repeat of Nigeria's 2026 Government Collapse (2028)

Intercontinental Trade Hit by Strict Pathogen Controls (2015)

Italy Addresses 'Immigrant Caregiver' Gap with Robots (2017)

Will Africa's Embrace of Authoritarian Capitalism a la China Continue?
(2018)
Proliferating Trade Networks in Eastern and Southern Africa Strengthen
Regional Ties (2023)

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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.

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.

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.

EXAMPLE:

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.

Now in 2020 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.

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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.

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.

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 "surveillance" 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 took on new levels of authority, as did regional systems like the Association of Southeast Asian Nations (ASEAN), the New Partnership for Africa's Development (NEPAD), and the Asian Development Bank (ADB). The worldwide spirit.

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"WHAT IS OFTEN SURPRISING ABOUT NEW TECHNOLOGIES IS COLLATERAL DAMAGE: THE EXTENT OF THE PROBLEM THAT YOU CAN CREATE BY SOLVING ANOTHER PROBLEM IS ALWAYS A BIT OF A SURPRISE." - Michael Free, Program for Appropriate Technology in Health (PATH)

HACK ATTACK

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

- The cost of capturing data through nanosensors and smart networks falls precipitously. In many developing countries, this leads to a proliferation of new and useful services, including "sousveillance" mechanisms that improve governance and enable more efficient use of government resources.
- Intelligent electricity, water distribution, and transportation systems develop in urban areas. In these "smart cities," internet access is seen as a basic right by the late 2010s.

Technology trends and applications we might see:

- Advances in low-cost mind-controlled prosthetics aid the 80 percent of global amputees who live in developing countries.
- Solar power is made vastly more efficient through advances in materials, including polymers and nanoparticles. An effective combination of government subsidies and microfinance means solar

is used for everything from desalination for agriculture to wi-fi networks.

- Flexible and rapid mobile payment systems drive dynamic economic growth in the developing world, while the developed world is hampered by entrenched banking interests and regulation.

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Despite such efforts, the global have/have-not gap grew wider than ever. The very rich still had the financial means to protect themselves; gated communities sprung up from New York to Lagos, providing safe havens surrounded by slums. In 2025, it was de rigueur to build not a house but a high-walled fortress, guarded by armed personnel. The wealthy also capitalized on the loose regulatory environment to experiment with advanced medical treatments and other under-the-radar activities.

Those who couldn't buy their way out of chaos-which was most people-retreated to whatever "safety" they could find. With opportunity frozen and global mobility at a near standstill-no place wanted more people, especially more poor people-it was often a retreat to the familiar: family ties, religious beliefs, or even national allegiance. Trust was afforded to those who guaranteed safety and survival-whether it was a warlord, an evangelical preacher, or a mother. In some places, the collapse of state capacity led to a resurgence of feudalism. In other areas, people managed to create more resilient communities operating as isolated micro versions of formerly large-scale systems. The weakening of national governments also enabled grassroots movements to form and grow, creating rays of hope amid the bleakness. By 2030, the distinction between "developed" and "developing" nations no longer seemed particularly descriptive or relevant. *

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Think Tanks - Rand etc. operations of death

Debilitating tourism and economies.

National Security Memorandum No. 200
Depopulation

CDC owns Patent on Ebola

Curfews and quarantine.

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Strong alliances laid the groundwork for more global and participatory attempts to solve big problems.

More effective vaccines improved healthcare.

Pharmaceuticals giants released thousands of drug compounds shown to be effective against diseases like malaria into the public domain as part of an "open innovation" agenda; they also opened their archives of R&D on neglected diseases deemed not commercially viable, offering seed funding to scientists who wanted to carry the research forward.

There was a push for major innovations in energy and water for the developing world, as those areas were thought to be the key to improving equity.

In many places, traditional social barriers to overcoming poverty grew less relevant as more people gained access to a spectrum of useful technologies- from disposable computers to do- it-yourself (DIY) windmills.

Given the circumstances that forced these new heights of global cooperation and responsibility, it was no surprise that much of the growth in the developing world was achieved more cleanly and more "greenly."

In Africa, there was a big push for solar energy, as the physical geography and low population density of much of the continent enabled the

proliferation of solar farms. **The Desertec initiative to create massive thermal electricity plants to supply both North Africa and, via undersea cable lines, Southern Europe was a huge success.**

By 2025, a majority of electricity in the Maghreb was coming from solar, with exports of that power earning valuable foreign currency. The switch to solar

created new "sun" jobs, drastically cut CO₂ emissions, and earned governments billions annually. India exploited its geography to create similar "solar valleys" while decentralized solar- powered drip irrigation systems became popular in sub-Saharan Africa.

There were still failed states and places with few resources. Moreover, such rapid progress had created new problems. Rising consumption standards unexpectedly ushered in a new set of pressures: the improved food distribution system, for example, generated a food production crisis due to greater demand.

Demand for everything was growing exponentially.

By 2028, despite ongoing efforts to guide "smart growth," it was becoming clear that the world could not support such rapid growth forever. *

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HEADLINES IN CLEVER TOGETHER

Global Economy Turns the Corner (2011)

Radical U.S. and China Emission Targets Signal New Era in Climate Change Negotiations (2015)

A First: U.S. Solar

Power Cheaper than Coal

(2020) Shortages Loom (2027)

'Info Cruncher' Is Grads' Job of Choice as Data Era Dawns (2016)

Consortium of Foundations Launches Third Green Revolution as Food Green Infrastructure Reshapes Economic Landscape (2018)

Transparency International Reports 10th Consecutive Year of Improved Governance (2025)

Technology trends and applications we might see:

- The cost of capturing data through nanosensors and smart networks falls precipitously. In many developing countries, this leads to a proliferation of new and useful services, including "sousveillance" mechanisms that improve governance and enable more efficient use of government resources.
- Intelligent electricity, water distribution, and transportation systems

develop in urban areas. In these "smart cities," internet access is seen as a basic right by the late 2010s.

- A malaria vaccine is developed and deployed broadly-saving millions of lives in the developing world.
- Advances in low-cost mind-controlled prosthetics aid the 80 percent of global amputees who live in developing countries.
- Solar power is made vastly more efficient through advances in materials, including polymers and nanoparticles. An effective combination of government subsidies and microfinance means solar is used for everything from desalination for agriculture to wi-fi networks.
- Flexible and rapid mobile payment systems drive dynamic economic growth in the developing world, while the developed world is hampered by entrenched banking interests and regulations.

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Research teams had been working for months to fabricate a new meat product-one that tasted just like beef yet actually contained only 50 percent meat; the remaining half was a combination of synthetic meat, fortified grains, and nano-flavoring.

In cities and villages around the world where children used to be hungry, access to higher-calorie meals had produced alarming increases in the incidence of obesity and diabetes. The demand for meat, in particular, was rising, but adding more animals to the planet created its own set of problems, such as more methane and spiking water demand.

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HACK ATTACK

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

Devastating shocks like September 11, the Southeast Asian tsunami of 2004, and the 2010 Haiti earthquake had certainly primed the world for sudden disasters. But no one was prepared for a world in which large-scale catastrophes would occur with such breathtaking frequency. The years 2010 to 2020 were dubbed the "doom decade" for

good reason: the 2012 Olympic bombing, which killed 13,000, was followed closely by an earthquake in Indonesia killing 40,000, a tsunami that almost wiped out Nicaragua, and the onset of the West China Famine, caused by a once-in-a-millennium drought linked to climate change.

Not surprisingly, this opening series of **deadly asynchronous catastrophes (there were more) put enormous pressure on an already overstressed global economy that had entered the decade still in recession. Massive humanitarian relief efforts cost vast sums of money, but the primary sources—from aid agencies to developed-world governments—had run out of funds to offer. Most nation-states could no longer afford their locked-in costs, let alone respond to increased citizen demands for more security, more healthcare coverage, more social programs and services, and more infrastructure repair.** In 2014, when mudslides in Lima buried thousands, only minimal help trickled in, **prompting the *Economist* headline: "Is the Planet Finally Bankrupt?"**

These dire circumstances forced tough tradeoffs. In 2015, the U.S. reallocated a large share of its defense spending to domestic concerns, pulling out of Afghanistan—where the resurgent Taliban seized power once again. In Europe, Asia, South America, and Africa, more and more nation-states lost control of their public finances, along with the capacity to help their citizens and retain stability and order. Resource scarcities and trade disputes, together with severe economic and climate stresses, pushed many alliances and partnerships to the breaking point; they also sparked proxy wars and low-level conflict in resource-rich parts of the developing world. Nations raised trade barriers in order to protect their domestic sectors against imports and—in the face of global food and resource shortages—to reduce exports of agricultural produce and other commodities.

With government power weakened, order rapidly disintegrating, and safety nets evaporating, violence and crime grew more rampant. Countries with ethnic, religious, or class

divisions saw especially sharp spikes in hostility: Naxalite separatists dramatically expanded their guerrilla campaign in East India; Israeli- Palestinian bloodshed escalated; and across Africa, fights over resources erupted along ethnic or tribal lines.

Meanwhile, overtaxed militaries and police forces could do little to stop growing communities of criminals and terrorists from gaining power. Technology-enabled gangs and networked criminal enterprises exploited both the weakness of states and the desperation of individuals. With increasing ease, these "global guerillas" moved illicit products through underground channels from poor producer countries to markets in the developed world. Using retired 727s and other rogue aircraft, they crisscrossed the Atlantic, from South America to Africa, transporting cocaine, weapons, and operatives. Drug and gun money became a common recruiting tool for the desperately poor.

Criminal networks also grew highly skilled at counterfeiting licit goods through reverse engineering. Many of these "rip-offs" and copycats were of poor quality or downright dangerous. In the context of weak health systems, corruption, and inattention to standards-either within countries or from global bodies like the World Health Organization-tainted vaccines entered the public health systems of several African countries. In 2021, 600 children in Cote d'Ivoire died from a bogus Hepatitis B vaccine, which paled in comparison to the scandal sparked by mass deaths from a tainted anti-malarial drug years later. The deaths and resulting scandals sharply affected public confidence in vaccine delivery; parents not just in Africa but elsewhere began to avoid vaccinating their children.

Technology hackers were also hard at work. Internet scams and pyramid schemes plagued inboxes. Meanwhile, more sophisticated hackers attempted to take down corporations, government systems, and banks via phishing scams and

database information heists, and their many successes generated billions of dollars in losses. Desperate to protect themselves and their intellectual property, the few multinationals still thriving enacted strong, increasingly complex defensive measures. Patent applications skyrocketed and patent thickets proliferated, as companies fought to claim and control even the tiniest innovations. Security measures and screenings tightened.

This "wild west" environment had a profound impact on innovation. The threat of being hacked and the presence of so many thefts and fakes lowered the incentives to create "me first" rather than "me too" technologies. And so many patent thickets made the cross-pollination of ideas and research difficult at best. Blockbuster pharmaceuticals quickly became artifacts of the past, replaced by increased production of generics. Breakthrough innovations still happened in various industries, but they were focused more on technologies that could not be easily replicated or re-engineered. And once created, they were vigorously guarded by their inventors-or even by their nations. In 2022, a biofuel breakthrough in Brazil was protected as a national treasure and used as a bargaining chip in trade with other countries. Verifying the authenticity of anything was increasingly difficult.

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Recognized seals of safety and approval proved ineffective when even those seals were hacked. The positive effects of the mobile and internet revolutions were tempered by their increasing fragility as scamming and viruses proliferated, preventing these networks from achieving the reliability required to become the backbone of developing economies-or a source of trustworthy information for anybody.

Interestingly, not all of the "hacking" was bad. Genetically modified crops (GMOs) and do-it-yourself (DIY) biotech became backyard and garage activities, producing important advances. In 2017, a network of renegade African scientists who had returned to their home countries after working in Western multinationals unveiled the first of a range of new GMOs that boosted agricultural productivity on the continent. But despite such efforts, the global have/have-not gap grew wider than ever. The very rich still had the financial means to protect themselves; gated communities sprung up from New York to Lagos, providing safe havens surrounded by slums. In 2025, it was de rigueur to build not a house but a high-walled fortress, guarded by armed personnel. The wealthy also capitalized on the loose regulatory environment to experiment with advanced medical treatments and other under-the-radar activities. Those who couldn't buy their way out of chaos-which was most people-retreated to whatever "safety" they could find. With opportunity frozen and global mobility at a near standstill-no place wanted more people, especially more poor people-it was often a retreat to the familiar: family ties, religious beliefs, or even national allegiance. Trust was afforded to those who guaranteed safety and survival-whether it was a warlord, an evangelical preacher, or a mother. In some places, the collapse of state capacity led to a resurgence of feudalism. In other areas, people managed to create more resilient communities operating as isolated micro versions of formerly large-scale systems. The weakening of national governments also enabled grassroots movements to form and grow, creating rays of hope amid the bleakness. By 2030, the distinction between "developed" and "developing" nations no longer seemed particularly descriptive or relevant. *

Millennium Development Goals Pushed Back to 2020 (2012)

Violence Against Minorities and Immigrants Spikes Across Asia (2014)

Islamic Terror

Networks Thrive in Doctors Without Borders

Latin America Confined Within Borders (2016) (2020)

Warlords Dispense Vital Medicines to Southeast Asian Communities (2028)

India-Pakistan Water War Rages (2027)

Congo Death Toll Hits 10,000 in Malaria Drug Scandal (2018)

Nations Struggling with Resource Constraints Race to Scale Synthetic Biology (2021)

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Philanthropy is less about affecting change than about promoting stability and addressing basic survival needs. Philanthropic organizations move to support urgent humanitarian efforts at the grassroots level, doing "guerrilla philanthropy" by identifying the "hackers" and innovators who are catalysts of change in local settings. Yet identifying pro-social entrepreneurs is a challenge, because verification is difficult amid so much scamming and deception.

The operational model in this world is a "fortress model" in which philanthropic organizations coalesce into a strong, single unit to combat fraud and lack of

trust. Philanthropies' biggest assets are their reputation, brand, and legal/financial capacity to ward off threats and attempts at destabilization. They also pursue a less global approach, retreating to doing work in their home countries or a few countries that they know well and perceive as being safe.

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TECHNOLOGY IN HACK ATTACK

Mounting obstacles to market access and to knowledge creation and sharing slow the pace of technological innovation. Creative repurposing of existing technologies-for good and bad-is widespread, as counterfeiting and IP theft lower incentives for original innovation. **In a world of trade disputes and resource scarcities, much effort focuses on finding replacements for what is no longer available.**

Pervasive insecurity means that tools of aggression and protection-virtual as well as corporeal-are in high demand, as are technologies that will allow hedonistic escapes from the stresses of life.

Technology trends and applications we might see:

- Echoing the rise of synthetic chemicals in the nineteenth century, synthetic biology, often state-funded, is used to "grow" resources and foodstuffs that have become scarce.
- New threats like weaponized biological pathogens and destructive botnets dominate public attention, but enduring technologies, like the AK-47, also remain weapons of choice for global guerrillas.
- The internet is overrun with spam and security threats and becomes strongly associated with illicit activity-especially on "dark webs" where no government can monitor, identify, or restrict activities.
- Identity-verification technologies become a staple of daily life, with some hitches-a database of retina recordings stolen by hackers in 2017 is used to create numerous false identities still "at large" in the mid-2020s.
- With the cost of cosmetic surgery dropping, procedures like the lunchtime facelift become routine among emerging middle classes.

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LIFE IN HACK ATTACK

Trent never thought that his past experience as a government intelligence officer would convert into something...philanthropic. But in a world full of deceit and scamming, his skills at discerning fact from fiction and developing quick yet deep local knowledge were highly prized. For three months now he had been working for a development organization, hired to find out what was happening in the "grey" areas in Botswana-a country that was once praised for its good governance but whose laws and institutions had begun to falter in the last few years, with corruption on the rise. His instructions were simple: focus not on the dysfunctional (which, Trent could see, was everywhere) but rather look through the chaos to see what was actually working. Find local innovations and practices that were smart and good and might be adopted or implemented elsewhere. "Guerrilla philanthropy" was what they called it, a turn of phrase that he liked quite a bit.

His trip into Botswana had been eventful-to put it mildly. On-time flights were rare these days, and the plane got diverted three times because of landing authorization snafus. At the Gaborone airport, it took Trent six hours to clear customs and immigration. The airport was bereft of

personnel, and those on duty took their time scrutinizing and re-scrutinizing his visa. Botswana had none of the high-tech biometric scanning checkpoints-technology that could literally see right through you-that most developed nations had in abundance in their airports, along their borders, and in government buildings. Once out of the airport Trent was shocked by how many guns he saw-not just slung on the shoulders of police, but carried by regular people. He even saw a mother with a baby in one arm and an AK-47 in the other. This wasn't the Botswana he remembered way back when he was stationed here 20 years ago as an embassy employee.

The organization that hired him was probably more right than it realized in calling it guerrilla philanthropy. After many weeks spent chasing down leads in Gaborone, then an unfortunate stint that had him hiking for miles alone through the Kalahari Desert, Trent found himself traveling deep into the Chobe Forest (a nice reprieve, he thought, from inhaling all that sand). One of his informants had told him about a group of smart youngsters who had set up their own biotechnology lab on the banks of the Chobe River, which ran along the forest's northern boundary. He'd been outfitted with ample funds for grant-making, not the forest bribes he had heard so much about; regardless of what was taking place in the world around him, he was under strict orders to behave ethically. Trent was also careful to cover his tracks to avoid being kidnapped by international crime syndicates-including the Russian mafia and the Chinese triads-that had become very active and influential in Botswana. But he'd made it through, finally, to the lab, which he later learned was under the protection of the local gun lord. As expected, counterfeit vaccines were being manufactured. But so were GMO seeds. And synthetic proteins. And a host of other innovations that the people who hired him would love to know about.

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SMART SCRAMBLE

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

The global recession that started in 2008 did not trail off in 2010 but dragged onward. Vigorous attempts to jumpstart markets and economies didn't work, or at least not fast enough to reverse the steady downward pull. The combined private and public debt burden hanging over the developed world continued to depress economic activity, both there and in developing countries with economies dependent on exporting to (formerly) rich markets. Without the ability to boost

economic activity, many countries saw their debts deepen and civil unrest and crime rates climb. The United States, too, lost much of its presence and credibility on the international stage due to deepening debt, debilitated markets, and a distracted government. This, in turn, led to the fracturing or decoupling of many international collaborations started by or reliant on the U.S.'s continued strength.

Also in trouble was China, where social stability grew more precarious. Depressed economic activity, combined with the ecological consequences of China's rapid growth, started to take their toll, causing the shaky balance that had held since 1989 to finally break down. With their focus trained on managing the serious political and economic instability at home, the Chinese sharply curtailed their investments in Africa and other parts of the developing world. Indeed, nearly all foreign investment in Africa-as well as formal, institutional flows of aid and other support for the poorest countries-was cut back except in the gravest humanitarian emergencies. Overall, economic stability felt so shaky that the occurrence of a sudden climate shock or other disaster would likely send the world into a tailspin. Luckily, those big shocks didn't occur, though there was a lingering concern that they could in the future.

Not that anyone had time to think about the future-present challenges were too pressing.

In the developed world, unemployment rates skyrocketed. So did xenophobia, as companies and industries gave the few available jobs to native-born citizens, shunning foreign-born applicants. Great numbers of immigrants who had resettled in the developed world suddenly found that the economic opportunities that had drawn them were now paltry at best. By 2018, London had been drained of immigrants, as they headed back to their home countries, taking their education and skills with them. Reverse migration left holes in the communities of

departure-both socially and literally-as stores formerly owned by immigrants stood empty.

And their homelands needed them. Across the developing world and especially in Africa, economic survival was now firmly in local hands. With little help or aid coming through "official" and organized channels-and in the absence of strong trade and foreign currency earnings-most people and communities had no choice but to help themselves and, increasingly, one another. Yet "survival" and "success" varied greatly by location-not just by country, but by city and by community. Communities inside failed states suffered the most, their poor growing still poorer. In many places, the failures of political leadership and the stresses of economic weakness and social conflict stifled the ability of people to rise above their dire circumstances.

Not surprisingly, across much of the developing world the rural-urban divide gaped wider, as more limited availability and access to resources like IT and trade made survival and self-sufficiency much more challenging for non-urban dwellers. Communications and interactions that formerly served to bridge one family or one village or one student with their counterparts in other places-from emailing to phone calls to web postings-became less reliable. Internet access had not progressed far beyond its 2010 status, in part because **the investment dollars needed to build out the necessary infrastructure simply weren't there. When cellphone towers or fiber optic cables broke down, repairs were often delayed by months or even years. As a result, only people in certain geographies had access to the latest**

"THE SPREADING OF IDEAS DEPENDS ON ACCESS TO COMMUNICATION, PEER GROUPS, AND COMMUNITIES OF PRACTICE. EVEN IF SOMEONE HAS BLUEPRINTS TO MAKE SOMETHING, THEY MAY NOT HAVE THE MATERIALS OR KNOW-HOW. IN A WORLD SUCH AS THIS, HOW DO YOU CREATE AN ECOSYSTEM OF RESEARCH AMONG THESE COMMUNITIES?"

- Jose Gomez-Marquez, Program Director for the Innovations in International Health initiative (IIH), MIT

communication and internet gadgets, while others became more isolated for lack of such connections.

But there were silver linings. Government capacity improved in more

advanced parts of the developing world where economies had already begun to generate a self-sustaining dynamic before the 2008-2010 crisis, such as Indonesia, Rwanda, Turkey, and Vietnam. Areas with good access to natural resources, diverse skill sets, and a stronger set of overlapping institutions did far better than others; so did cities and communities where large numbers of "returnees" helped drive change and improvement. **Most innovation in these better-off places involved modifying existing devices and technologies to be more adaptive to a specific context. But people also found or invented new ways-technological and non-technological-to improve their capacity to survive and, in some cases, to raise their overall living standards.** In Accra, a returning Ghanaian MIT professor, working with resettled pharma researchers, helped invent a cheap edible vaccine against tuberculosis that dramatically reduced childhood mortality across the continent. In Nairobi, returnees launched a local "vocational education for all" project that proved wildly successful and was soon replicated in other parts of sub-Saharan Africa.

Makeshift, "good enough" technology solutions-addressing everything from water purification and harnessing energy to improved crop yield and disease control-emerged to fill the gaps. Communities grew tighter. Micro-manufacturing, communal gardens, and patchwork energy grids were created at the local level for local purposes. Many communities took on the aura of co-ops, some even launching currencies designed to boost local trade and bring communities closer together.

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HEADLINES IN SMART SCRAMBLE

National Medical Labs in Southeast Asia Herald New Diagnostics for Native Diseases

(2013)

Low-Cost Water Purification Device Halves Diarrhea Deaths in India

(2015)

Chinese Government Pressured as Protests Spread to 250 Cities (2017)

'Returnee' Innovators Struggle to Expand Sales Beyond Home Markets

(2020)

Maker Faire Ghana Partners with 'Idol' Franchise to Spotlight Young

Innovators (2027)

Famine Haunts Ethiopia-Again (2022)

VC Spending

Within Sub-Saharan Africa Triples (2025)

Philanthropy operations are decentralized; headquarters are less important, and the ability to quickly access different parts of the world and reconfigure teams on short notice is key. Office space is rented by the day or week, not the month or year, because more people are in the field-testing, evaluating, and reporting on myriad pilot projects.

TECHNOLOGY IN SMART SCRAMBLE

Economic and political instability fracture societies in the developed world, resources for technology development diminish, and talented immigrants are forced to return to their countries of origin. As a result, capacity and knowledge are distributed more widely, allowing many small pockets of do-it-yourself innovation to emerge. Low-tech, "good enough" solutions abound, cobbled together with whatever materials and designs can be found. However, the transfer of cutting-edge technology through foreign direct investment is rare. Structural deficiencies in the broader innovation ecosystem - in accessing capital, markets, and a stable internet-and in the proliferation of local standards limit wider growth and development.

Technology trends and applications we might see:

- Energy technology improvements are geared more toward efficiency-getting more from existing sources of power-than new-generation technologies, though some local improvements in generating and distributing wind and geothermal energy do occur.
- Breakdowns in the global medicine supply chain accelerate the emergence of locally bioengineered super-strength homeopathic remedies, which replace antibiotics in the dispensaries of many developing-world hospitals.
- Widespread micro-manufacturing, using 3D printers, enables the fabrication of replacement components for engines and machines, allowing "perpetual maintenance" to compensate for broken trade links.
- Garden allotments proliferate in mega-cities as new urban-dwellers seek to supplement a scarce food supply and

maintain their agricultural heritage.

- Technically advanced communities use mesh networks to ensure high-speed internet access, but most rural poor remain cut off from access.

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LIFE IN SMART SCRAMBLE

The beat-up six-seater plane in which **Lidi** was the lone passenger lurched suddenly. She groaned, grabbed the armrests, and held on as the plane dipped sharply before finally settling into a smooth flight path. Lidi hated small planes. But with **very few commercial jets crisscrossing Africa these days**, she didn't have much choice. Lidi - an Eritrean by birth - was a social entrepreneur on a mission that she deemed critical to the future of her home continent, and enduring these plane flights was an unfortunate but necessary sacrifice. Working together with a small team of technologists, Lidi's goal was to help the good ideas and innovations that were emerging across Africa to spread faster-or, really, spread at all.

In this, Lidi had her work cut out for her. Accelerating and scaling the impact of local solutions developed for very local markets was far from easy-especially given the patchiness of internet access across Africa and the myopic perspective that was now, in 2025, a widespread phenomenon. She used to worry about how to scale good ideas from continent to continent; these days she'd consider it a great success to extend them 20 miles. And the creative redundancy was shocking! Just last week, in Mali, Lidi had spent time with a farmer whose co-op was developing a drought-resistant cassava. They were extremely proud of their efforts, and for good reason. Lidi didn't have the heart to tell them that, while their work was indeed brilliant, it had already been done. Several times, in several different places.

During her many flights, Lidi had spent hours looking out the window, gazing down on the villages and cities below. She wished there were an easier way to let the innovators in those places know that they might not be inventing, but rather independently reinventing, tools, goods, processes, and practices that were already in use. What Africa lacked wasn't great ideas and talent: both were abundant. The missing piece was finding a way to connect those dots. And that's why she was back on this rickety plane again and heading to Tunisia. She and her team were now concentrating on promoting mesh networks across Africa, so that places lacking internet access could share nodes, get connected, and maybe even share and scale their best innovations.

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This report is the result of extensive effort and collaboration among Rockefeller Foundation initiative staff, Foundation grantees, and external experts. The Rockefeller Foundation and GBN would like to extend special thanks to all of the individuals who contributed their thoughtfulness and expertise throughout

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