Emerging Technologies: Should They Be Internationally Regulated?

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Mankind has really popped the planet in the jaw the last few centuries: six million hectares is lost to deforestation every year; the ocean is increasingly acidic and void of fish; the planet's sixth mass extinction seems to be underway; and human-caused climate change is already raising sea levels, aggravating droughts, and increasing the frequency and intensity of extreme weather events like Hurricane Sandy.

One possible remedy to these and other grave threats to the planet comes from "emerging technologies" like bioengineering, nanotechnology, artificial intelligence (AI), and geoengineering. With an influx of government support and a budding marketplace, scientists are developing emerging technologies at a rapid pace, placing mankind on the cusp of being able to create life, engineer microscopic mechanical systems, alter the entire atmosphere, and create superintelligent AI.

But sometimes the solution is even more dangerous that the problem (if you release a mongoose upon a snake, well, now you have a mongoose to deal with).

The very same emerging technologies that some tout as a panacea to the world's problems also pose the risk of causing global catastrophes—the type of events where millions of people die and the earth is seriously harmed, perhaps irreversibly. Such "global catastrophic risks" have a relatively low probability of occurring but massive consequences if they do. Therefore, mankind must be very careful never to let a global catastrophe occur.

A quick look at a few emerging technologies demonstrates their potential to benefit us all or, if we are unlucky or unwise, wreak havoc.

BIOENGINEERING

With bioengineering, scientists tweak living things at the molecular level to create new and novel characteristics. Bioengineering is perhaps best known for GM food: 94 percent of soybeans by acre are genetically engineered, and genetically altered animals like salmon—deemed safe by the FDA and nearing final approval for consumption—are beginning to enter the marketplace.

But bioengineering is quickly advancing beyond food as scientists begin to create an array of dangerous bioengineered organisms. One recent example occurred at the University of Wisconsin-Madison, where scientists engineered a strain of the H5N1 virus (the bird flu) to be transmittable through the air rather than through direct contact. The normal H5N1 bird flu killed a reported 60 percent of people with reported infections, and although the fatality rate is actually

smaller since not all infections were reported, an airborne H5N1 epidemic could kill tens of millions of people. Even deadlier is the mousepox virus developed in Australia that, rather than sterilizing mice as intended, had a 100 percent fatality rate (a quite morbid form of birth control).

Two general risks arise from this situation: the first that a deadly bioengineered organism will accidentally escape from the lab, as the Foot and Mouth Virus did through a leaky pipe in the UK in 2008, and the second that bioterrorists will "weaponize" legitimate bioengineering research. The latter concern is why the National Science Advisory Board for Biosecurity (NSABB)—a federal committee that provides guidance on deadly agents— recommended that *Science* and *Nature* not publish data on the engineered H5N1 virus. The journals complied even though the NSABB has no formal power to issue a moratorium on research (the studies were later released with NSABB support).

Bioterrorists could also just steal a deadly bioengineered virus. Four crooks broke into a state-of-the-art vault in Belgium and stole $100 million worth of diamonds in 2003, so why couldn't they break into a laboratory?

Synthetic biology seems to have the highest stakes and ethical dubiousness of all forms of bioengineering. In synthetic biology, bioengineers write a DNA code from scratch rather than using the traditional method of stitching together existing DNA strands. The code is plugged into a DNA synthesizing machine, which spews out DNA molecules that can then be inserted into a hallowed-out cell. In 2010, the prolific scientist Craig Venter followed this recipe to create what he called "the first self-replicating species we've had on the planet whose parent is a computer."

The risks of synthetic biology are generally unknown, but with amateur "biohackers" springing up around the world and the necessary hardware becoming widely available on the web, society has reasonable grounds to be worried. Some concerns are that synthetic organisms could devastate biodiversity or be used to create incredibly deadly biological weapons.

On the other hand, the benefits of bioengineering are spectacular. For example, bioengineering could revolutionize human health—imagine a cure to cancer and a flood of new vaccines. Bioengineering could also create abundant new food sources to assuage global hunger, clean water for the one in six people who lack it, or produce bioengineered algae that slurps up CO2 and excretes biofuel. These benefits are no less than revolutionary.

GEOENGINEERING

Geoengineering involves tweaking the Earth's environment to combat the effects of climate change. Recent, entrepreneur Russ George "went rogue" and caused great controversy by conducting a small-scale geoengineering experiment: he dumped 100 tons of iron dust into the Pacific Ocean off of Canada to create a massive algae bloom, which seemingly violating two international treaties. The idea behind this technology is to create a massive algae bloom that absorbs CO2 and then sinks to the bottom of the ocean, but the overall ecological effects are generally unknown.

Another geoengineering technique to slow climate change is to simply block sunlight from hitting the earth. David Keith and James Anderson of Harvard are developing a plan to spray sun-reflecting aerosols from a hot air balloon in New Mexico into the atmosphere as a pilot project for potential widespread use. Geoengineering projects like this will only become more common as humanity becomes desperate to slow down the effects of climate change, yet these efforts really amount to a massive experiment that could have unintended results on weather patterns, the ozone layer, and food supplies.

NANOTECHNOLOGY

Another emerging technology, nanotechnology, involves creating materials or systems at the unfathomably small scale of 1 to 100 nanometers, or 100,000 times smaller than a human hair. "Nanomaterials" are materials that are reduced to the nanoscale and consequently exhibit new properties like increased flexibility or lightness. They are already prevalent on the marketplace in hundreds of products like computer displays, cosmetics, and paint. However, nanomaterials have an unnaturally small size and other unique qualities that pose health risks because they may be able to, for example, more easily permeate human lungs or cell walls in plants.

In the future, scientists will develop entire *systems* composed of nanotech parts—in other words, incredibly small machines. They may also develop molecular manufacturing technologies, in which nanomachines construct products molecule by molecule—sort of the ultimate advancement in 3D printing. Imagine technologies like ultra-efficient and thin solar panels, massive and cheap energy sources, and nanorobots that clean up oil spills. However, this technology also comes with its risks, like nanotechnology weapons more devastating than any nuclear or biological weapon and far more difficult to detect.

ARTIFICIAL INTELLIGENCE

AI is simply computers that are "intelligent," or in other words, humanlike in their thinking. Insiders refer to AI that can meet or surpass human intelligence as "Strong AI." Current AI is "Weak AI" and can do things like drive a car (Google's driverless car), defeat former Jeopardy champions (IBM's Watson), or perform a comedy routine that can be adjusted in real-time based on audience reaction (likeable comedian robot Data). As for the future, some experts predict the forthcoming of "the Singularity," which is the point at which computers have intelligence somewhere between humans and God.

Such superintelligence machines could potentially solve some of the world's biggest problems, being able to develop revolutionary technologies or create cures to all diseases, for example—dilemmas that mankind is, apparently, too feeble-minded to solve. On the other hand, there is a chance that superintelligent AI could suffer a mechanical failure, catch a virus, or be programmed to harm mankind, in which case this technology could be incredibly dangerous.

OUR ONLY HOPE AGAINST CLIMATE CHANGE?

Some advocates cite emerging technologies as mankind's only hope to confront otherwise unsolvable problems like climate change. Unchecked greenhouse gas emissions threaten most of the world—from Mozambique to Manhattan—yet two decades of international negotiations have not produced an effective climate change treaty. The 1997 Kyoto Protocol was the best attempt, but the United States never ratified the agreement despite today being responsible for 17.9 percent of global GHG emissions, and massive polluters like China and India are exempt from mandatory emission cuts because of an exception for developing countries. Since 2005, the year the Kyoto Protocol became effective, global CO2 emissions rose from 29.3 billion tons to 33.9 billion tons.

The next round of climate change negotiations are currently underway in Doha, but countries like the United States and China are in a political deadlock over what responsibilities massive polluters that are still developing their economies should have, making a post-Kyoto climate change treaty quite improbable in the near future.

And even if the international world does manage to slash greenhouse gas emissions, there is about a 40-year delay between the point of emission and the correlating temperature increase, so cutting all emissions today means only that the planet would stop warming from greenhouse gases in about 2052.

However, throw geoengineering into the mix, and scientists would be able to either remove massive amounts of carbon from of the atmosphere or limit the amount of sunlight that the Earth absorbs—the two main types of geoengineering technologies. Or if ExxonMobil's planned $600 million investment synthetic biology guru Craig Venter pans out, then an army of synthetic algae organisms could convert atmospheric carbon dioxide into billions of gallons of fuel. If scenarios play out, then perhaps the Kyoto Protocol would not be worth the paper the treaty is printed on.

BIOENGINEERING UNDER INTERNATIONAL LAW

One way to protect mankind from dangerous emerging technologies is through international law. With the stakes so huge—the lives of millions and the inhabitability of the earth are in play—one would think that governments would already be taking major precautions. Why not still let innovations thrive and develop emerging technologies for the benefit of society, but also hedge our bets against global catastrophes by implementing practical safeguards? Sadly, this has not been the case, so far, with very little progress being made at the international level.

Bioengineering makes an excellent case study because there are several treaties that touch on this emerging technology but that are overall vastly inefficient. For example, the Convention on Biological Diversity requires that parties "regulate, manage, or control" Living Modified Organisms (LMOS), which includes dangerous bioengineered organisms, but the treaty does not lay out specific actions that laboratories must take to ensure that deadly bioengineered organisms do not escape or reach the hands of terrorists. And while some countries at a 2012 CBD meeting attempted to issue a moratorium on the environmental release and commercial use of synthetic biology, these efforts fell grossly short: the final agreement merely "urges" countries to take a "precautionary approach" to synthetic biology.

The Cartagena Protocol on Biosafety, which expands on the CBD, further regulates LMOs that could adversely affect biological diversity. However, the scope of this treaty is largely trade-focused, so the domestic activities of laboratories with lax safety standards are largely exempt. Even the risk assessment and risk management requirements only go as far as a nation's own individual protection goals. And even if a dangerous LMO is released into the environment that threatens other countries, the offending party merely has to notify the countries that will be threatened ("*Hey Obama-man, this is PM Stephen Harper up North. You know that super virus in our lab? Well, you might want to call in sick for work, ha ha*").

Finally, under the Biological Weapons Convention (BWC), a country must not develop, produce, stockpile, or otherwise acquire or retain biological agents or toxins. However, there is an exception whenever these acts are for peaceful purposes, which exempts the bulk of activity involving extremely dangerous bioengineered organisms. Furthermore, the treaty does not establish any formal verification mechanism to monitor compliance with its requirements.

Overall, these treaties do not go far enough to reduce the risks of emerging technologies that put the entire world at danger. And even if they did, the United States did not ratify any of these treaties, and so they are not bound by their terms. A universal treaty on emerging technologies would go a long ways to protect mankind from these risks.

WHAT WOULD AN INTERNATIONAL EMERGING TECHNOLOGIES TREATY LOOK LIKE?

A new international treaty could protect humanity from global catastrophes while still allowing for the safe developing of emerging technologies. With emerging technologies rapidly increasing in sophistication and accessibility, countries should come together in a relatively quick time period to make tough decisions on the future of the earth.

One way to do this is to have a body of experts composed of scientists, NGO representatives, lawyers, government representatives, and so forth—all with some level of scientific expertise—from around the world to act as a regulatory body within the terms of the agreed upon treaty. While the countries themselves would want to have veto power, this group of experts would at least be able to conduct the bulk of operations and monitor the safety of various emerging technologies from around the world.

Furthermore, each country could be required to impose domestic measures—laws to regulate laboratory safety, geoengineering tests, the release of living bioengineered organisms into the environment, publication of dangerous research, the sale of advanced scientific instruments like DNA synthesizers, and so forth. Either the aforementioned body of experts or a separate judicial body could monitor each country's progress and enforce the treaty's requirements—with significant penalties to deter noncompliance.

Finally, a treaty on emerging technologies should be truly global. Otherwise, scientists engaging in dangerous practices could just conduct their work in an unregulated country. Take physicist Richard Seed, who threatened to clone a human in Mexico or Japan if the United States made it illegal to do so. This would also allow the international community as a whole to decide

upon a level of protection that reflects an appropriate risk level as determined by all countries, which is fitting because global catastrophes threaten everyone on the planet. Finally, because emerging technologies have vast moral and religious implications—creating life and altering the atmosphere are not whimsical choices, after all—a global treaty would allow people all across the planet to influence the direction of the human species.

Soon, the international community must come to terms with the massive strides being made in various emerging technology fields. While some countries have taken steps to protect themselves from risks posed by emerging technologies, most countries have resisted action, particularly industry-leaders like the United States. While these technologies could save humanity from their own missteps and solve lots of other problems along the way, the risk of a global catastrophe is real and should be respected. Hopefully, humanity gets it right before things go wrong.