

Technology Is Making Our Lives Complex

CARL O. PABO

Modern civilization has set a trap for itself, as ever more complex technologies are deployed at an accelerating rate. Every second, billions of devices, protocols, ideas, traditions, and people interact around the world. The resulting increase in complexity poses a huge and possibly unmanageable challenge.

Experts understand parts of the system, but the whole is far beyond the comprehension of any scientist, citizen, or political leader. To address the big global challenges of the next decade, we need a paradigm shift in societal regulatory systems to break us out of the complexity trap.

While humanity arrived at this point gradually, there have been foreshocks at earlier stages of technological development. Over the last several hundred years, science and technology, guided by reason and knowledge, have clearly improved daily life for most of humanity. But progress is not linear. Each advance produces some kind of disruption and side effects that society then struggles to address.

For example, the Haber-Bosch process for artificial fixation of nitrogen increased agricultural yields but has led to waterways around the world being polluted with runoff from excessive use of some fertilizers. Chlorofluorocarbons, used as refrigerants, caused the ozone hole, but efforts to replace them gave rise to hydrofluorocarbons, which are dangerous greenhouse gases. And although antibiotics have saved hundreds of millions of lives, they are now used so widely that drug-resistant strains have become a new risk to human health. There are many more such examples across all areas of science and technology.

Such problems arise because of system-level effects that are not obvious when new



technologies are first introduced and deployed. Unanticipated consequences can occur at almost any level - chemical, biological, computational, economic/financial, or social/political. But emergent complexity (moving beyond any prospect of direct human comprehension) becomes an increasingly serious problem with the rise of computers, as individual components of the system become smarter, interact more rapidly, and connect on a global scale.

All of these challenges are intertwined with broader issues concerning science and society. As a scientist myself, I had studied the structure and design of DNA-binding proteins, but I resigned a tenured faculty position in MIT's biology department to look at the larger challenges of human thought and humanity's future. I studied finance, cognitive neuroscience, governance, climate change, the risks of environmental degra-

tion, and the dangers posed by the rise of artificial intelligence. And one thing became clear: the limits of human cognitive capacity leave us struggling to grasp the complexity of the problems now facing the planet.

So, what are we to do? It is not reasonable to ask scientists or other experts to anticipate the full effects of their work. Instead, a new approach to handling emerging complexity should begin by recognizing that this complexity engenders two kinds of external costs (or "externalities") paid by society as a whole. Some involve direct damage, such as when Facebook was used to incite hatred and disrupt the 2016 US presidential election. Others are less direct, such as the time and attention needed to sort through new problems and develop effective plans to address them.

As with other externalities - like those associated with fossil fuels - society faces a fundamental challenge in allocating com-

plexity's costs and benefits in a fair, reliable, and well-structured way that ensures that those developing and selling new technologies repay society for the external costs. For starters, we need better methods for evaluating potential problems. Companies developing new technologies, for example, should evaluate and mitigate risks at key points in the research, development, and implementation processes. These evaluations should aim to anticipate a range of potential outcomes and weigh their respective costs and benefits to society.

These initial working assumptions do not solve the complexity problem, but they frame it well enough to serve as a call for advice and comment. Open-ended discussions could be funded by governments or tech companies, or by philanthropists who want to preserve democracy and guarantee a livable human future.

Democracy and capitalism, coupled with modern science, have given rise to a remarkable flourishing of thought, creativity, expression, and invention, which has entrenched the longstanding assumption that knowledge - and prospects for human control of our fate - would steadily increase. But we have now entered a phase in which increasing complexity is creating a world that no one understands in detail.

Escaping this trap will require more than a technical fix involving a clever new program, device, or brain implant. I think the discussion should begin with gating mechanisms and new types of regulatory schema that can serve as precautionary tools when technology is first introduced.

Ultimately, though, we will need to upgrade our very methods of thought. This is a call to global action, worthy of our brightest minds. The author is the founder and president of Humanity 2050.

Project Syndicate

Invaluable Traditional Knowledge



MANEKA GANDHI

I have been trying to grow chillies in my vegetables garden for several years now. The leaves curl and the output is very little. I have been trying to solve the problem by snipping off the curled leaf bunches (and scolding the plants every morning) but with no impact. I do not use any chemicals at all. Homemade neem spray has not been effective. Now I learn that the most effective way to stop leaf curl is to sprinkle or spray buttermilk (Chaas) on the leaves. Pouring buttermilk on the roots helps growth as do used tea leaves.

Every few years I write about the amazing innovations across India sourced by Prof Anil Gupta and his team in Srishthi. Poor people are not poor in grassroots knowledge, ethics and values. In fact, if we used them for frugal innovations which are knowledge intensive rather than material intensive, instead of ramming inefficient urban solutions down their throat, government might save crores of rupees and get development that makes us happier, instead of more frustrated.

Honeybee, the magazine that regularly comes out with the traditional knowledge systems of the village, should be made mandatory reading by every bureaucrat / technocrat and politician. They will learn how the country really works and who are its true heroes.

It is now celebrating 25 years in existence and has come out with a thick volume of innovations and useful traditions. I am reprinting a few from thousands:

- I have been trying to grow chillies in my vegetables garden for several years now. The leaves curl and the output is very little. I have been trying to solve the problem by snipping off the curled leaf bunches (and scolding the plants every morning) but with no impact. I do not use any chemicals at all. Homemade neem spray has not been effective. Now I learn that the most effective way to stop leaf curl is to sprinkle or spray buttermilk (Chaas) on the leaves. Pouring buttermilk on the roots helps growth as do used tea leaves.
- One of my favourite plants, which has now disappeared on the ground and from public memory, is/was Sadaasuhaagan, which in Uttar Pradesh is called Besharam/Behaya and Naffatiyo in Gujarati. It grew in wetland, waterlogged areas and till recently we saw it everywhere; large purple, blue or pink morning glory type flowers. Now, when it has almost gone, we find that it was used for abscesses, fungal skin infections, maggot infested wounds, rheumatism. In Bolivia it is used as a remedy for cancer, diabetes, as sedatives, anti-bacterials, anti-convulsants and liver protectors. It cures leucoderma, promotes menstruation and guards the body against heavy metals. In fields it can be used as an insecticide against aphids, leaf folders, thrips, beetles, army worms and cutworm caterpillars. All in all an amazing plant which has been allowed to disappear because the wetlands are disappearing and no scientist has bothered to use this plant. Someone should send this information to Baba Ramdev's team of medicine makers.
- A team of organic scientists have just finished a survey of the soil in my constituency Pilibhit a completely agricultural area that grows only wheat / rice / sugarcane / men-



tha. They found the soil totally contaminated with 38 pesticides. No wonder the cancer and other disease rates are so high. Unfortunately the government, while talking a lot about organic farming, has not got a single scheme as yet. I have been pushing and pushing to turn Pilibhit organic. The best way to turn any area organic is not to give money as compensation but to give knowledge. The Chief Minister of Sikkim simply banned all chemical pesticides and fertilizers and each farmer was taught by 800 trained teachers on how to turn organic. Today it is 100% organic. I need this team to be paid to come to my area but any effort to ask the Agriculture ministry to do that has fallen on deaf ears. They have Rs. 400 crores for organic farming and they are spending it by taking ONE acre at a time at random and making it chemical free. A total waste of time and money. Anyway, in winter all of us eat Mungphali or peanuts. Soak peanut skin in water, mulch it and put it in the ground, specially paddy and pigeon pea. It results in a much higher yield.

- Tamarind Trees are now almost extinct in North India. We are importing a much inferior tamarind from Southeast Asia. It is one of our most magnificent trees. Apart from its many medicinal benefits and delicious taste, its leaves are dried and used for storing seeds and keeping them viable for many years. Any state government, specially Uttar and Andhra Pradesh, should start a Tamarind tree mission and plant at least 1 crore trees.
- Finally a good way to use tobacco: cereals are kept in gunny bags. To prevent pests from attacking them, the bags should be dipped in water in which tobacco leaves have been soaked for 24 hours and then dried in the

shade for 24 hours. Then the cereals should be kept in them.

- Srishthi has, on my request, brought a new kind of apple tree to Pilibhit one that grows in the plains and gives quintals of apples. They distributed 100 trees and almost all have survived. Imagine if they work. Poor people with just one bigha of land will earn more through the trees than through chemical infested grain.
- Digging a pit for vermicompost is very difficult to do and to maintain. Earthworms disappear into the neighbouring soil, water floods it, mosquitoes and flies emerge, it is attacked by rats, ants and termites etc. Hang a clothes line between two trees and hang the bags on the line. Apply grease at both ends of the rope. Take plastic sacks, make holes in them, fill up with waste matter and put a hundred worms in each one. Add cowdung and spray with a little water every few days. Vermicompost will be ready in 45 days. The number of worms will increase as well and can be used for more sacks.
- Every six months Srishthi does a Shodhyatra. Volunteers trek across any selected area in the country, with projectors and other devices, to record homegrown knowledge and innovations. When they come across outstanding teachers, inventors and communities, they felicitate them. So far 34 such yatras from Anantnag to Idukki have been done.

Animal rights and environment activist, Maneka Gandhi writes weekly column 'Heads & Tails' for the Kashmir Observer. She can be reached at: gandhim@nic.in