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Destructive Creation and the New World Disorder

PAUL HARRIS AND DANIEL SAREWITZ

Much of the global economy melted down in 2008. Three nuclear reactors at Japan's Fukushima Daiichi power plant melted down in 2011. This pair of catastrophes, though very different, sprang from the same fundamental cause: a proliferation of complexity and uncertainty in the world, produced largely because of humankind's increasing prowess in science and technology.

SCIENCE

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Before the two disasters occurred, mathematical models that help manage the economic risk of highly leveraged investments, and nuclear reactors that help power the global energy system, were both seen as important contributors to the economic growth that in recent decades has raised standards of living for hundreds of millions around the world. After the meltdowns, the unavoidable question was: "How could we have been so stupid?"

Because humanity depends on complex technological systems to survive and thrive, and because this dependence creates ever-expanding domains of uncertainty and unpredictability, an inescapable incoherence lies at the core of modern society. The incoherence ensures a tragic element in the modern world's quest for progress and control, and this tragedy is woven as intricately into the web of human affairs as were the mood swings of the gods into ancient Greek dramas.

The key to the modern tragic dilemma is this: Modern market democracies depend on technological advance for the economic growth that undergirds their political stability. But technological advance is also the source of societal and economic disruption that can threaten such stability. This inherent tension plays itself out every several generations in paroxysms of economic decline and social unrest.

The rationale for technological advance is clear. According to the functionalist logic of a consumerist, globalized, capitalist system, technological advance is understood to be a key catalyst for wealth creation, especially through boosting economic productivity and adding novelty and value to the economy via new types of processes and products.

Thus, governments increasingly have gotten into the act of promoting technological advance. Since World War II, most market democracies have invested directly in research and development, and have sought to develop a portfolio of policy tools—such as intellectual property regimes, technical standard-setting, technology procurement programs, tax incentives, and rules for public-private collaborations—aimed at accelerating technological innovation in the private sector. The global economic downturn has only magnified the political and cultural obsession with innovation as the secret sauce for future growth.

But to promote innovation through scientific and technological advance is also to promote social change—often radical social change. Since the Industrial Revolution, spectacular growth in market economies has been powered by wave after wave of technological transformation: textiles and water power; railways and steam power; steel and electrification; automobiles and mass production; and, most recently, information and communication technologies. The economic, political, social, and cultural differences between today's world

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and the largely agrarian society of, say, the mid-nineteenth century cannot easily be overstated.

GAINING STEAM

Technological change is social change. A quick look at what railroads did to the structure of society in the mid-nineteenth century suffices to illustrate. Aspects of life as fundamental as the assumed relations between space and time, relations that had been stable for much of human history, were annihilated. The effects were both literal, as coordinated time zones had to be invented to accommodate scheduling, and cultural, as the reliability and speed of railroads restructured expectations about communication, mobility, behavior, and predictability.

The modern corporation was created to a significant extent by the new demands of managing railroads. Railroads were also at the center of an enormous expansion of both innovative and economic activity, as new markets were created in sectors as diverse as steel production, telegraphy, machine tools, and agriculture.

In the process, railroads destroyed livelihoods and social structures by replacing slow, local-to-regional networks of industry, commerce, and transport with fast, national ones. They helped create modern, total warfare by enabling rapid movements of large numbers of troops and facilitating reliable and rapidly extendable supply lines. They stimulated overinvestment, new models of debt financing, and commodity price deflation that in turn led to economic depression and social disruption in the United States and Europe in the 1870s and 1880s—which in turn contributed to the rise of the union movement and socialism and a destructive resurgence of nationalism.

And as the economic and social importance of railroads was displaced by new waves of technological change—electrification and steel; automobiles and oil—these led to additional "adjustments" whose economic, social, political, and technological consequences were factors behind the Great Depression and World War II.

Economists, and indeed Western societies more generally, have sought to come to terms with the dual nature of technological change by insisting that the social and economic devastation wrought by such change is more than compensated for by the wealth creation and social opportunities that technological transformations make possible. An evocative term for this complex tension is "creative destruction," a concept formalized by the Austrian-American economist Joseph Schumpeter, who, updating Marx, made groundbreaking efforts during the 1930s and 1940s to explain how technological change has driven the apparently cyclical nature of recent economic history.

New technological tools and opportunities quickly render existing modes of economic activity inefficient and even nonsensical. They create completely new modes of generating wealth, along with cultural shifts and new social relations. And while most societies have come to view the cumulative impact of these waves of change as the underlying dynamo of modern progress—each wave leading to a new level of productivity, wealth creation, and material benefit—this view conceals the reality that tens of millions of people will pay a high cost for such progress.

IN THE TROUGH

Thus the economic, cultural, and social disruption that much of the industrialized world (and beyond) is now experiencing can be usefully understood as, in significant part, a consequence of the past 50 years of extraordinarily rapid technological change and resulting economic growth. From a Schumpeterian perspective, we may now recognize ourselves as being within the trough of a wave of creative destruction.

To escape from the trough, leaders prescribe an acceleration of technological change in the hope that this will create the next wave of expanded prosperity. Our dominant, often heroic cultural narratives of innovation—just think of the public outpouring of grief after the death of Steve Jobs—focus on the creation, not on the destruction.

From within the trough, however, the consequences of world-transforming innovation look more like destructive creation than creative destruction. With worries about economic prospects rising over the past few years in many countries, awareness of the destructive effects of innovation has started to grow. In market economies, this awareness finds particular expression in concerns about jobs and the equitable distribution of the benefits of economic growth—hence new protest movements like the *indignados* in Spain and Occupy Wall Street in America.

But even when policy debates about manufacturing jobs in countries such as the United States and Australia pay brief, euphemistic attention to the "replacement rate" by which businesses replace human workers with new technologies (particularly through information and communication

technologies, but increasingly with robots as well), they quickly return to the paramount importance of science- and technology-led innovation in helping companies climb up global value chains.

In seeking to assess innovation performance at the national level, policy makers generally prefer to highlight startups rather than shutdowns—industrialization rather than deindustrialization—even though we know that a commitment to shiny new factories through innovation is also a commitment to old, empty, rusty ones.

This asymmetry is understandable. At best, it reflects a shared belief in the value of the human desire to inquire, explore, understand, and explain. The better angels of our nature, we tell ourselves, invent, innovate, and improve. At worst, however, this glossing-over the incoherence at the heart of modern society produces an obscured view of options and alternatives, and an unquestioned faith that the best cure for the victims of progress can only be more progress.

The perspective of destructive creation provides an alternative lens to bring into clearer focus the complex and tragic essence of our commitment to innovation.

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It allows us to see the essential similarity of the 2008 financial meltdown and the 2011 nuclear meltdown, and also to bring into the discussion such apparently disparate events as the terrorist attacks against the United States in September 2001, the levee system failure that devastated New Orleans during Hurricane Katrina in 2005, and the Deepwater Horizon oil spill of 2010. All of these events were products of incomprehensible complexity—uncertainty—created by new technologies and technological systems, and by the dependence of humans on such technologies for their economic prospects and day-to-day needs.

Sophisticated risk models once looked like a useful tool for allowing banks to lend money to people of modest means who wanted to own homes. Air travel once appeared merely to be an important mode of global transport and commerce. But after the financial meltdown, risk models looked like enablers of the irresponsibility and corruption that brought the global economy to the brink of disaster. And after 9/11, jet aircraft looked like terrorist weapons, ones that launched a decade of warfare and geopolitical realignment—contributing mightily, in the process, to a US budget deficit that is a central focus of debates on how to deal with the ongoing downturn.

Technological complexity thus cuts across disparate levels of experience and action and does so in ways that yield neither to prediction nor control. The complexity is comprehensible only in part, and often only in retrospect.

OPPORTUNITIES FOR DISASTER

People can benefit from new technologies in direct and relatively immediate ways—from the enjoyment of a new iPad, for example, or the economic benefits of a job in the consumer electronics industry. But even at the individual level, we can experience what in 1928 Lewis Mumford termed the "ambivalence" of the machine—we enthusiastically make use of new tools and processes while also experiencing longer-term consequences unrelated to the machine's apparent function. We avidly adopt new information and communication technologies, for instance, while also experiencing a sharp decline in privacy.

At larger scales of consideration, the chains of causation between technological choices and societal consequences become impossible to apprehend in their particulars. Yet it is apparent that the rusted-out factories of the American industrial heartland—and the persistent unemployment, underemployment, and income inequality that result—are as much a consequence of the information technology revolution as the iPad is.

In making automobiles affordable for the middle class, Henry Ford did not set out to create an economic bubble that would contribute to the Great Depression, or erode the vitality of the American urban neighborhood, or modify the chemistry of the Earth's atmosphere. But he assuredly played a part in each of those developments.

Modernity's dependence on technological change is not only linked to what economists euphemistically call "structural adjustment"—as old industries, employment patterns, and allocations of wealth and power give way to new ones. It also affects the evolution of what Thomas Hughes, the historian of technology, termed "large technological systems." These make up the infrastructure on which humans depend for their survival, infrastructure whose continually growing complexity

defies not just control but even comprehension: energy systems, food and agricultural systems, transport systems, national defense systems, medical systems, and so on.

And while we acknowledge with awe humanity's ability to manage elements of these systems (such as civil airline safety or vaccine efficacy) with incredible reliability and effectiveness, we also see that, as these systems become more sophisticated and complex, they generate new opportunities not just for benefit but for disaster. Impacts range from the merely inconvenient and costly (like the effect of Icelandic volcanoes on global air travel), to the disruptive (economic and employment inequity as some industries shut down and others prosper), to the momentous and apparently intractable (nuclear weapons proliferation; climate change)—and increasingly global.

Such complexities cannot be understood in an analytically coherent way. Rather, societies tend to make sense of complexity through narratives of self-identity, through custom, belief systems, myths, and taboos. In the industrialized world we make sense of complexity via notions of progress that celebrate the creative and sweep aside the destructive aspects of innovation.

Of course this sense-making in part reflects shared cultural values—the Enlightenment commitment to rationality and progress—but it also reflects the interests of those with the power to shape our guiding cultural myths and narratives. Thus, the choices we make about how to deal with "destructive creation" are strongly political. To navigate the socio-technical complexity at the core of modernity, we ought to depend on the vitality of democratic institutions. Yet modern societies have increasingly tended to go in a different direction, often handing responsibility for coping with destructive creation to their most culturally authoritative sense-maker: scientific research.

RISKY BUSINESS

From the scientific perspective, the "destruction" of destructive creation often goes by the name "risk." The implication is that undesirable aspects of technological change can be controlled through rigorous quantification and rational management, making the world safe for continued technological change and economic growth.

Through, for example, research on climate change, nuclear waste, or the health effects of toxic chemicals, we are supposed to comprehend the consequences of destructive creation, so that we can act to prevent or redress the unintended negative consequences of endless growth. The notion of "risk" thus reinforces the creative and redemptive aspects of technological change by marginalizing the destructive aspects as something to be measured and managed, like the side effects of a drug.

But science can never be more than one of many means to navigate the irreducible complexity of the world. As science is called on more and more to "solve" unsolvable problems, it becomes increasingly political—not because its facts are not objective, but because they are partial and often disconnected. Even a cursory examination of debates around issues like climate change, embryonic stem cell research, and the regulation of pharmaceuticals and toxic chemicals shows that contesting sides, in advancing their positions, invoke a mélange of factual assertions, value preferences, vested interests, and, perhaps most importantly, beliefs about how the world works and ought to work.

Rusted-out factories are as much a consequence of the information technology revolution as the iPad is.

Consider the broad rejection of genetically modified foods (GMFs) in Europe. Public opinion research shows that in rejecting GMFs, Europeans have focused not on economic benefits but on concerns like preserving their landscape, the taste of their foods, and the viability of their farmers—value commitments that could be strongly affected by processes of destructive creation.

So, while debates over GMFs in Europe have often been carried out in the language of scientific assessments of risk to health and environment, the main reasons for public opposition have to do with values about the sort of society that people prefer. The scientific patina is required by the rules of the World Trade Organization, which prohibit blocking GMF imports for reasons other than scientific assessment of risk.

A comparison with the politics of climate change is revealing. Opponents of GMFs share with skeptics about climate change a commitment to arguing against the weight of conventional science, although the two groups' political and economic perspectives are likely to be in sharp

opposition. Because determinations of risk are always uncertain and never fully resolvable, and because one person's risk is another's opportunity, science becomes a battle that is really about the nonquantifiable, value-based consequences of destructive creation—about who gets to determine how the world will be transformed.

Indeed, the core challenge of destructive creation is that it presents us with, to borrow from Hegel's definition of tragedy, the need to choose between two rights. What cherished aspects of our ways of life are we willing to give up in the pursuit of growth and wealth creation? This definition of tragedy does not imply inevitable doom, but it does entail an inescapable process of balancing conflicting values.

As the ancient Greeks knew, this choosing is made more difficult—and potentially disastrous—if we fail to recognize and understand our situation. In the case of genetically modified foods, the use of scientific analysis and language in a debate really about conflicting values only serves to further cloud what is at stake in efforts to manage the destructive creation that follows.

DEMOCRATIC IMAGINATION

The Enlightenment tradition at the core of modernity values progress and scientific rationality—but not alone. Democracy is another prized scion of the Enlightenment, and the commitment to democracy is an explicit acknowledgment that unmediated rationality can become a source of tyranny. Democracy provides the pluralistic discourse that can prevent rationality from being captured by a particular ideology or set of interests. It provides the balance to ensure that one incomplete way of looking at the world does not through over-weening confidence become dominant. It allows us to integrate many factors that make life meaningful—the tangible and intangible, the factual and the fanciful.

Historically, during periods of social disruption accompanying structural readjustment, those disenfranchised by technological change have made new demands for a voice. The historian Carroll Pursell describes the ways in which science and technology were perceived during the Great Depression, and the pervasive ambivalence about the social impacts of innovation that fed into a movement for a science moratorium. In his second inaugural address in 1937, President Franklin Roosevelt felt the need to address concerns about "moral controls over the services of science," a perspective that would find little resonance amid today's dominant political and economic rhetoric.

The catastrophe of World War II put an end to this debate. It may be only slightly melodramatic to note that not until they lived under the shadow of the mushroom cloud did certain industrial societies begin to enjoy a return to economic growth, from which reemerged a prevailing cultural narrative about the "endless frontier" of science and technological development, and its contribution to a prosperity that could be shared by all.

The redemptive myths of technological progress have attained a status—reinforced by asymmetries of political and economic power—that stifles complementary myths of humility, pluralistic debate, and cooperation. Evidence for this is to be found precisely in the consequences of structural adjustment, which our cultural identity seems able to interpret only as motivation for the next wave of destructive creation.

We are looking toward that next wave even now. From fields like nanotechnology, synthetic biology, robotics, genomics, and cognitive technology we will be creating new industries, vast new wealth, and marvelous new conveniences, even as we are adding to global-scale technological complexities that will transform society and bring us our next versions of the dot-com and housing bubbles, 9/11, oil spills, and Fukushima.

So perhaps now is the time to engage in a rebalancing of the assumptions about how much destruction we are willing to put up with as we busily try to stoke the next fire of creation. How can we improve democratic steering of powerful technologies and technological systems, and who will make the choices about our priorities? Who will get to capture the new wealth we create, and who will be left on the sidelines? How big will we allow speculative bubbles to grow? How much of the new wealth will we put aside to help those who are disenfranchised by technological change? Whose jobs will be forfeited? Whose cities will rust?

There are, of course, no single right answers to these questions. What is important is to ask them seriously and openly, and not pretend that they can be avoided. They are not questions for science, but for a revitalized democratic imagination. Perhaps the *indignados*, Occupy Wall Street, and even the Tea Party are signs of a reawakening of that imagination. We do not know how deep the current trough will go, but our view of the modern tragedy is much clearer from down here than it will be when we reach the crest of the next wave. ■