Technology, Progress and Paul Diesing

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Abstract. There is stark disagreement in both the popular and the professional literature about the nature of technology and whether technological progress is a good thing in an urbanized world. We find our solution to the puzzle in the work of Paul Diesing, a philosopher who created a framework of the social sciences consisting originally of five types of rationality—defined as effectiveness-- in decision-making. (We have added a sixth type of rationality, as explained below.) Using Diesing's framework, technology may be defined as "technical-economic systems of practical knowledge used to define and solve problems". We see Diesing's six types of rationality as representing interdependent, and often conflicting, types and aspects of progress. Diesing's work suggests to us that proponents and critics of technology should distinguish between technical and economic rationality (progress). They should also consider the differential effects of social, legal, political, and ecological rationality.

Key words: technology, progress, Diesing.

"The essence of technology is nothing technological"

Martin Heidegger, *The Question Concerning Technology*

What is progress and how does it relate to technology? From time out of mind, the lives of nearly everyone were blighted by misery, tedium, ignorance, disease, and early death. Even the prominent and wealthy could not purchase immunity, as the physicians' lethal decision to bleed George Washington well illustrates. We look back at where humanity was, and in a fit of self congratulation, marvel at our progress in an urbanized world, pointing to antibiotics, flat screen televisions, computers, air conditioning, automobiles, cell phones, airplanes, and endlessly on and on. All these have made our lives more interesting, more comfortable, more healthy, more fun. Technology is even changing our minds for the better, writes Clive Thompson. We have access to prodigious external memory; today's digital tools make it very easy to find connections between ideas, pictures, people and events; and there has been an explosion of communication

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and publishing.[1] All these illustrate the fabulous promise of technology. As Emerson asked in "Progress of Culture," "Who would live in the stone age or the bronze or the iron or the lacustrine? Who does not prefer the age of steel, of gold, of coal, petroleum, cotton, steam, electricity, and the spectroscope?"[2] Not to mention the iPod and the Prius and the tiny polymer wafer inserted into the brain to deliver tumor dissolving drugs.[3]

Yet popular culture (which is typically delivered via some recently developed technology) is also replete with variations on the theme of dystopian technology, which dominates innumerable movies, video games, graphic novels, and the like. Innovations, of course, signal change, and change will always seem threatening to many. For some of our most notable thinkers, the promise of technology is a promise broken. In Huxley's *Brave New World* (1931), technology numbs us into docility; in Orwell's *1984* (1949), it denies us privacy and autonomy; in movies like *Metropolis* (1927) and *Blade Runner* (1982), it contests our very notion of humanity.

This paper suggests a way of resolving the paradox. We begin by examining the work of some prominent critics of technology and contrast their work with typical counterarguments, noting that the two (or three or four) sides tend to talk past each other. There is no agreement as to how "technology" should be defined or how it influences society as a whole. We then turn to the work of Paul Diesing, a neglected philosopher of the social sciences, and his six types of rationality or effectiveness. We argue that technical, "economic", social, legal, "political", and ecological rationality constitute six interdependent but often conflicting types of progress.[4] Diesing's types of rationality constitute a comprehensive framework of the social and natural sciences, which can be used to make sense of the blooming, buzzing confusion of the world in general and of the "technology" problem in particular.[5] Technological "progress" may be destructive if it ignores systematic effects or if the term is inappropriately applied to non-technical problems.

Criticism of Technology

Criticism of technology has a long and tangled history. Lewis Mumford made technology the centerpiece of his long and influential career, which focused on the nature and development of cities. In *Technics and Civilization*[6] and *The Myth of the Machine*[7], Mumford argued that technologies were initially small scale, and hence possible to control. Everything changed with urbanization and industrialization. After observing the rise of the Nazis, Mumford concluded that as technologies become large, complex, and sophisticated, they become attractive and useful to authoritarian elites. Mumford argued that technologies had become so immense and

[1] Clive Thompson, *Smarter Than You Think: How Technology is changing our minds for the better* (New York: Penguin Press, 2013), 8-9.
[2] *Collected Works*, ed. Glen M. Johnson and Joel Myerson (Cambridge: Belknap Press, 2010).
[3] For an examination of progress in the conventional sense, see *Angus Deaton, The Great Escape: Health, Wealth and the Origins of Inequality* (Princeton, N.J.: Princeton University Press, 2013).
[4] Diesing, uses the terms "economic" and "political" in a different manner than is commonly used today. For example, "economic" to Diesing, writing in 1962, refers to the meaning of the term in neo-classical economics.
[5] Diesing originally formulated his framework of types of rationality in *Reason in Society: Five Types of Decisions and Their Social Conditions* (Urbana: University of Illinois Press, 1962). As described below, Diesing would have added a 6th type of rationality had this book been written after 1970.
[6] (New York: Harcourt, Brace, 1938).
[7] (New York: Harcourt, Brace, 1967, 1970), 2 vols.

omnipresent that they had taken on a life of their own. Even those who helped to propel them along could no longer shape or direct them.

The French social theorist Jacques Ellul elaborated on the problem of technology and autonomy. In *La Technique ou L'Enjeu de Siecle,* (1954),[8] Ellul wrote that the key to modern Western civilization is technique, by which he meant rational methods intended to maximize efficiency. This focus resulted from the Enlightenment and the industrial revolution in the 18th and 19th centuries, but today techniques spawn further techniques, all uncontrolled by politics, ethics, religion, or even economics. Thus, while initially techniques served humanity, now human values are subordinated to techniques, which have assumed the role of sacred idols in Western society. Whatever can be done is done, even if the result is anti-human. The result for Ellul is rampant consumerism, materialism, and ethical relativism, as means swallow ends.

Technique, Ellul maintained, also results in a concentration of production and capital that exaggerates inequalities and creates a dense "world not built on a human scale." Human problems are reconceived as technical problems, so while technique frees us from drudgery and scarcity, it also breeds alienation and consigns many of us to social or economic irrelevance. Even the problems technique solves are often the problems it caused; if technique was indispensable to the defeat of fascism, it was also indispensable to its rise. All modern states are dominated (or infected) by this ideology of technique; in this sense, the differences among states are less important than this overriding commonality. That the ideology is rarely recognized as such exempts it from attack or even examination.

Ralph Waldo Emerson, a 19th century Transcendentalist, also complained about the dehumanizing potential of technology. Emerson admonished us to "look far deeper for our salvation than to steam, photographs, balloons or astronomy. . . . Machinery is aggressive. The weaver becomes a web, the machinist a machine." [9] Karl Marx, in *The Poverty of Philosophy,* gave Emerson's complaint a different twist, rooting the problem less in technology than in the economic system. "The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist."[10]

Marcuse, writing in the Marxian tradition, believed that technology will continue to be used to repress individuality, trivialize life with dull materialism, and manipulate desires through advertising and the media, although he allows that new types of instrumental reason could generate a new and more positive science. Jürgen Habermas is even more pessimistic, rejecting the idea of a new science and technology as a romantic myth.[11] Leading members of the Frankfurt School of philosophy Theodor Adorno and Max Horkheimer argued in *Dialectic of Enlightenment* (1972) that "instrumentality is in itself a form of domination, that controlling objects violates their integrity, suppresses and destroys them".[12] Martin Heidegger wrote in "The Question Concerning Technology" (1977) that "the essence of technology is nothing technological". It is an instrumental view of nature. Nature "becomes a gigantic gasoline station", nothing more than an exploitable resources to be used for our purposes. Heidegger

[8](Paris: Armond Colin, 1954).
[9] Ralph Waldo Emerson, *Works* (Boston and New York, 1909).
[10] Ed. C.P. Dutt and V. Chattopadhyaya (New York: International Publishers, 1936).
[11] Andrew Feenberg, "Marcuse or Habermas: Two Critiques of Technology," *Inquiry*, 39, no. 1 (March 996): 48.
[12] Cited in Andrew Feenberg, "Marcuse or Habermas: Two Critiques of Technology," *Inquiry: An Interdisciplinary Journal of Philosophy* 39, No. 1 (March 1996), 45.

nevertheless acknowledges the benefits technology has brought.[13] C.S. Lewis wrote pointedly: "Man's power over nature is really the power of some men over others with nature as their instrument."[14]

Has the magic of computers, which have reduced the impossible to the commonplace, caused these critiques to vanish? Not at all. Indeed, in the past twenty years or so movements have emerged which are opposed to the Internet, vaccination, fluoridation, genetically modified agriculture, and so forth. The consequences of these new technologies, these critics believe, are unpredictable but possibly disastrous; or technology is only the latest and most cunning means for government or corporations to control us; or technology is unnatural, replacing peaceful, orderly existence with abrupt, risky change; or technology imposes painful costs on innocent parties, like workers and consumers.

Occasionally, neo-Luddites make their point with vandalism and violence. Most often, they simply hold meetings and write articles. Occasionally, violence and non-violence are conjoined. Kirkpatrick Sale, an intellectual leader of the neo-Luddites, smashed a computer on the stage of Town Hall in New York. "It was astonishing how good it made me feel!" he told a reporter. "It felt wonderful. . . . Civilizations as such are all catastrophic, which is why they all end by destroying themselves and the natural environment around them."[15] Perhaps, the best known neo-Luddite manifesto is "Industrial Society and Its Future."

> The Industrial Revolution and its consequences have been a disaster for the human race. They have greatly increased the life-expectancy of those who live in "advanced" countries, but they have destabilized society, have made life unfulfilling, have subjected human beings to indignities, have led to widespread psychological suffering . . . and have inflicted severe damage on the natural world. The continued development of technology will worsen the situation. It will certainly subject human beings to greater indignities and inflict greater damage on the natural world, it will probably lead to greater social disruption and psychological suffering, and it may lead to increased physical suffering even in "advanced" countries.[16]

So wrote Theodore Kaczynski, aka, the Unibomber, who in his own way labored to decrease life expectancy and to increase social disruption and psychological suffering.

In one sense, it is hard to quarrel with these critics. Technology does often seem like a horse riding man, instead of the reverse. Entrepreneurs do not simply seek to satisfy needs; they try to create needs, utilizing sly marketing gambits to outwit us. In the famous words of Steve Jobs, "It's not the customer's job to know what they want." Products that did not exist a few years ago, like the iPad, may today be regarded as necessities, valued perhaps as much for the status and sophistication they convey as for the functions they perform. None of this can be accomplished without large private and public organizations, operated with a cold legalese that cannot nourish the soul. Human beings, who originated in tiny, nomadic bands, now find that huge cities and complexity can overwhelm the spirit.

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[13] Martin Heidegger, *The Question Concerning Technology* (New York: Harper & Row, 1977). W. Brian Arthur summarizes Heidegger's dense argument in The Nature of Technology: What It Is and How It Evolves (New York: Free Press, 2009), pp. 213-214.

[14] Cited in Ted Howard and Jeremy Rifkin, *Who Should Play God? The Artificial Creation of Life and What It Means for the Future of the Human Race* (New York: Dell, 1977), p. 8.

[15] Kevin Kelly, "Interview with the Luddite," *Wired*, 3.6(1995).

[16] (Madison, WI: Jolly Roger Press, 1995).

In a sense, what we have at the passionate extremes are competing utopias: the lovers of technology imagining how it will free humanity from the bonds that have restrained us since the time of Adam *versus* the enemies of technology, imagining how wonderful life would be, were it not for these latest and greatest of human perils. What this suggests is that each side is engaged in a kind of spiritual striving – and it is this striving and not the numbers crunching that explains their appeal and the voracious antagonisms they excite. Langdon Winner writes:

> . . . a concept that was once very specific in the way it was used has now become amorphous in the extreme. There is a tendency among those who write or talk about technology in our time to conclude that technology is everything and everything is technology. In a dialectic of concepts that Hegel would have appreciated, the word has come to mean everything and anything; it therefore threatens to mean nothing.[17]

The Nature of Technology

The economist Robert Heilbroner discussed the interaction of technology and society in a 1967 article entitled: "Do Machines Make History?" The essay is considered a classic, although the terms "machine" or "technology" are never defined. Heilbroner saw technology following a mild kind of determinism, featuring developmental sequences, rather than simply popping up here and there. Viewed from this perspective, technology affects the course of political history (think the printing press and atomic bombs), social attitudes (think contraceptive pills), and the very context of our lives (think how cars and air conditioning made the Sunbelt an attractive place to live). Tweaking Marx, Heilbroner observes, "It was not only the steam-mill that gave us the industrial capitalist but the rising inventor-manufacturer who gave us the steam-mill."[18]

Is technology machines? Robert Merrill, a mechanical engineer, calls technologies "bodies of skills, knowledge, and procedures for making, using, and doing useful things. They are techniques, means for accomplishing recognized purposes."[19] A leading textbook by Rudi Volti sees technology as "a system created by humans that uses knowledge and organization to produce objects and techniques for the attainment of specific goals."[20] Volti Illustrates the centrality of systems by discussing the humble light bulb:

> The invention of a practical, long-lasting light bulb rested on the development of a serviceable filament and the use of an improved vacuum pump that evacuated the interior of the bulb, thereby preventing the combustion of the filament. But by itself, a light bulb was useless. An effective electrical generator was needed to supply the current that produced the incandescence of the filament. A network of electrical lines had to be strung up between the generator and the individual homes, shops, and factories. And metering

[17] *Autonomous Technology: Technics-out-of Control as a Theme in Political Thought* (Cambridge, Mass.: MIT Press, 1977), 9-10.
[18] "Do Machines Make History?" *Technology and Culture*, 8.3 (1967), 335. In "Technological Determinism Revisited," Heilbroner defines "machine" as "both individual mechanisms and a general level of technological development". In Merritt Roe Smith and Leo Marx, *Does Technology Drive History?* (Cambridge, Mass.: MIT Press, 1994), 69.
[19] "The Study of Technology," *Encyclopedia of the Social Sciences*, vol. 15, p. 577.
[20] Rudi Volti, *Society and Technological Change*, 7th ed. (New York: Worth, 2014), p.6.

> devices were necessary so that users could be accurately billed for the electricity they used.[21]

Volti's system encompasses all kinds of technology, some related to the generation of light and others to paying for it. As a practical matter, they are all connected, but as the metering device has its own essentials (money and numbers, for example), it quickly becomes evident that this system will gobble up everything in an endless infinite regress. All this "technology" is useless without a demand for energy. However, questions of supply and demand are central to the field of economics rather than engineering.

What, then, is technology? One school of thought conceives technology as essentially a process. Thus, Elull speaks of a rational method, Mumford and Marcuse of a mode of organizing, Merrill of skills, knowledge, and procedures, and Volti of a system that produces objects and techniques to achieve human purposes. Yet this approach is not entirely satisfactory. Analytically, we sense a difference between Volti's bulb and the economic system that permits it to light, and understand that a definition of amoeboid boundaries is not very useful in this context.

In his 2009 book *The Nature of Technology*, W. Brian Arthur writes that answers to the question "What is technology?" are annoyingly unclear.

> Technology, we are told, is a branch of knowledge, or the application of science, or a study of techniques, or a practice, or even an activity. The Oxford English Dictionary declares with a lovely stuffiness that technology is 'the collection of mechanical arts that are available to a culture to make its economy and society function'.[22]

He then asks: ". . . can technology really be knowledge and applied science and a study of something and a practice and a collection? All at the same time?" Arthur himself provides not one, but three related definitions of the term: 1) a means to fulfill a purpose; 2) an assemblage of practices and components, and 3) the entire collection of devices and engineering practices available to a culture. [23]

Arthur's fundamental contribution lies in describing the origin of new technologies, which tells us much about the nature of technology itself. He writes that a novel technology is one that uses a new principle to link purposes to outcomes. For example, airplanes used to be powered by pistons-and-propellers. After the advent of the turbojet, they were powered by gas turbine engines with reactive thrust, a different principle entirely.

Some principles are borrowed from another technology; some come from combining previous concepts; some are remembered from the past; and some are suggested by theory. Inventions, or mental associations, may start from either end of the technological chain—from needs/purposes or from a newly discovered phenomenon or effect. Arthur gives the following example of need-based innovation:

> In the 1920s, aircraft designers realized they could achieve more speed in the thinner air at high altitudes. But at these altitudes reciprocating engines, even when supercharged

[21] *Ibid*., p.5.
[22] New York: Free Press, 2009, p. 27.
[23] Ibid., pp. 28-29.

> with air pumped up in pressure, had trouble drawing sufficient oxygen, and propellers had less "bite". Needed was a different principle from the piston-propeller one.[24]

At the other end of the chain, innovation may begin with a newly observed phenomenon, as when Alexander Fleming noticed that spores of a mold inhibited the growth of staphylococci bacteria and realized that this could help prevent infections.[25]

The second stage of innovation involves finding solutions to sub-problems. This is an ongoing process; technologies appear in improved versions. Finally, Arthur writes of a pyramid of causality, writing that "novel technologies are created out of building blocks that are themselves technologies".[26]

> In fact, supporting any novel device or method is a pyramid of causality that leads to it: of other technologies that used the principle in question; of antecedent technologies that contributed to the solution; of supporting principles and components that made the new technology possible; of phenomena once novel that made these in turn possible; of instruments and techniques and manufacturing processes used in the new technology; of previous craft and understanding; of the grammars of the phenomena used and of the principles employed; of the interactions among people at all these levels described.[27]

The "Social Construction of Technology" approach is a useful complement to Arthur's pyramid of causality. Robert Pool, for example, notes that the triumph of gas-powered cars over steam-powered cars had little or nothing to do with their respective engineering merits. Once the choice has been made, however, the institutionalization of the professions and the existence of large organizations push everybody in the same direction.[28] This is the phenomenon known as path dependence. Path dependence is reinforced by the influence of interest groups on legislative and regulatory bodies.[29] Finally, there is the issue of complexity. Pool writes:

> ". . . technology has reached the point where no individual can understand completely how, say, a petrochemical plant works, and no team of experts can anticipate every possible outcome once a technology is put to work. Such complexity fundamentally changes our relationship with technology.[30]

Complexity is of particular concern with respect to the transfer to technologies from developed to developing societies, where the social context is fundamentally different. An entire literature has developed around the concept of "appropriate technologies".[31] Finally, complexity is a

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[24] Ibid., p. 111.
[25] Ibid., pp. 118-119.
[26] Ibid., p. 203
[27] Ibid., pp. 123-124.
[28] "How Society Shapes Technology," in Albert Teich, ed. *Technology and the Future*, 11th ed., ed. Albert Teich (Boston, MA.: Wadsworth, 2006), 14-15.
[29] See, for example, Robert A. Caro, *The Power Broker: Robert Moses and the Fall of New York* (New York: Random House, 1974).
[30] Pool, p. 16.
[31] Rudi Volti writes: ". . . after Western experts introduced large tractors into Pakistan, farm owners replaced farm laborers with the new machines. In one region, 40 percent of these workers lost their jobs and thus were forced to migrate to the cities and lives of dire poverty. Per-acre crop yields hardly increased at all." *Society and Technological Change*, p. 88.

central feature of the world economy today. The economic crisis of 2007-2009 was so fantastically complicated that no one really understood what was happening.[32]

Paul Diesing and Technology

The central argument of this paper is that we can improve our understanding of the concepts of technology and technological progress through the work of Paul Diesing (1922-2011). Diesing was a philosopher of the social sciences. He learned by doing qualitative and quantitative studies in virtually all of the social science disciplines. A sociologist, economist, psychologist, political scientist, anthropologist, and even a gifted musician, Diesing was omnivorous in his curiosity and remarkable for his insights. Yet today, perhaps because of a self-effacing temperament, he does not even merit an entry in Wikipedia. Painfully aware of his relative anonymity, he wrote: "The worst fate a publication can suffer is to be ignored. This happens when there is no community that can use or build on its ideas and data, and also no community whose turf is threatened by it. Such a work exists in an empty space."[33]

Trained in philosophy at the University of Chicago, Diesing became involved with an anthropological project studying the Fox Indians of Iowa, which impressed on him the importance of social context and the fatally abstract quality of rational choice theory. Conflict resolution and problem solving, accordingly, became a major focus of his six books and several journal articles-- in the context of labor-management relations, international politics, and the policy-making process. His book *Conflict Among Nations: Bargaining, Decision Making, and System Structure in International Crises*, with Glenn Snyder (1977), quickly became a classic in its field. In the latter part of his academic career at SUNY-Buffalo, Diesing became a neo-Marxist and did not return to the framework of types of rationality that he had developed in his first book, *Reason in Society* (1962). His new perspective is evident in *Science & Ideology in the Policy Sciences* (1982/2005), which examines all the major schools of thought related to public policy from 1930 to 1970. The index to *Reason in Society* contains no reference to "technology". However, in *Science & Ideology*, Diesing wrote:

> But the development of capitalist technology is not an increase in neutral efficiency; it is a separation between the mental and muscular aspects of work and a gathering of the mental aspects into the control of management (Braverman, 1974, Chapter 3). . . . In Marxist terms, the forces of production are not neutral technology, but embody capitalist social relations of production—capitalist domination and exploitation of labor.[34]

Diesing wrote in 1962 that there were five--and only five-- fundamental types of rationality or practical reason: technical, economic, social, legal, and political. However, in 1984 he told the present writer that if he had written *Reason in Society* after 1970, when ecological scholarship first emerged in books like Barry Commoner's *The Closing Circle*, he would have included ecological rationality in his framework.[35] We thus speak of six types of

[32] See Timothy F. Geithner, *Stress Test: Reflections on Financial Crises* (New York: Broadway Books, 2014).
[33] Diesing, *How Does Social Science Work?, Reflections on Practice* (Pittsburgh: University of Pittsburgh Press, 1991), p. 195.
[34] (New Brunswick: N.J.: Aldine/Transaction, 1982/2005), 267.
[35] Interview in Paul Diesing's house in, Buffalo, N.Y., August 25, 1984.

rationality in this paper. The implications of this change for Diesing's understanding of technology were profound. He writes:

> The critique is of the linear thinking that treats a technique merely as a means to an end and ignores all its other systemic effects. You can never do just one thing, says the ecologist, and ignorance of the systemic effects of new chemicals should be a reason for extreme caution in introducing new techniques. Instead, our engineers and technologists have been rushing new techniques and substances into production. They are guilty not only of linear thinking but of a technocratic faith, the belief that unlimited technological development will solve all mankind's problems.[36]

The types of rationality described in *Reason in Society* are not only fundamental ways of thinking; they are also developmental trends in society, each representing a particular value. To simplify, technical rationality concerns production and is the basic way engineers think. Raw materials enter a system, are processed, and become products. Its concern is with the efficient achievement of a given goal. Economic rationality concerns the comparison of value and exchange and is the way [*neoclassical*] economists think.[37] However, in the evaluation of ends and means, economic rationality is a solvent that may dissolve moral and religious rules of right and wrong. Measuring and putting a price on something – like sex, for example – may change its meaning. Social rationality, followed by psychologists, psychiatrists, anthropologists, clergy, and many sociologists, speaks to public opinion, emotions, and the unconscious, which are often considered "irrational" in everyday language. Integration is the value most associated with social rationality.[38] Legal rationality is represented by lawyers, bureaucrats, and some religious leaders, who attempt to solve problems by creating structures of rules.[39] This includes rules about what is right and wrong. Diesing's political rationality refers to decision-making structures.[40] A rational decision-making structure, simultaneously differentiated and integrated, is able to produce timely, authoritative decisions based upon diverse sources of information. Ecological rationality, which we have added to the original five types of practical reason, is concerned with systemic, non-linear, environmental outcomes, since everything is connected to everything else.[41]

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[36] Paul Diesing, *Science & Ideology in the Policy Sciences* (New Brunswick, N.J.: Transaction, 2005), 301. The book was originally published in New York by Aldine in 1982.

[37] "Economic decisions attempt to maximize the achievement of given ends (goals, desires, interests, needs) through the careful use of available means, in a situation where not all ends can be fully achieved." Paul Diesing, "Socioeconomic Decisions," *Ethics* LXIX No. 1 (October 1958): 1. Behavioral and financial economics have broken away from neoclassical economics to incorporate social rationality, which is to say psychological, social and emotional factors in the economic decisions of individuals and institutions.

[38] "Social decisions attempt to change personalities and social relations in the direction of greater fundamental harmony and stability." *Ibid*., p. 2.

[39] Diesing defines the legal broadly as "all rules explicitly agreed on as binding by a group". *Roads to Reason*, p. 129.

[40] "The political structure of a group is the organization of forces which determines how its decisions are made, that is its decision-making structure. Political science is the study of decision-making structures." Ibid., p. 170. Note that political science, like other disciplines, has evolved since Diesing wrote these lines. This does not make Diesing's framework of rationality dated; it simply means that the framework no longer corresponds to the current structure of individual academic disciplines, which typically try to expand in competition with other disciplines.

[41] For a more complete description of Diesing's types of rationality, see Richard Hartwig, "Paul Diesing and Social Science," *Urbana* 8.1 (2003-4), 1-22, urbanauapp.org/. What we call ecological rationality is described in Ch. 10 of

Each of Diesing's types of rationality has a "substantial" and a "functional" aspect. Substantial rationality deals with the achievement of a particular type of value, like efficiency for technical and economic rationality. Functional rationality is the rationality of organizations; it deals with the achievement of a value over a period of time. The goal of putting a man on the moon within ten years after 1960 is an example of substantial rationality; maintaining the capability of NASA after the moon landing is an example of functional rationality. W. Bryan Arthur illustrates functional rationality in writing:

> The pyramid of causality supports the micro-process of invention much as a logistics system supports an army in battle. . . . This would be like explaining the Battle of Waterloo in terms of the histories of the regiments that fought, their military culture, their training and equipment, their previous accomplishments, and their supply lines. These ultimately account for battles won, but normally we focus on the actions and decisions at the sharp end of military engagements where the actual fighting takes place.[42]

In the context of the Diesing framework, what most people consider "technology" encompasses *both* technical *and* economic rationality. The failure to grasp this explains many of the problems afflicting thought on the subject. For example, most people would say that automobiles and computers have changed the world. But what does this mean? Would a dozen cars and computers have changed the world? Obviously not. What has changed the world is *millions* of cars and computers. Technology may have made mass production possible, but it was economics—supply matched by demand--that made it practical and desirable, thus initiating and driving the process. It was not technological advances alone that created the outcomes deplored by Ellul, Mumford, and Marcuse; it was some combination of technological and economic rationality—mediated by social, political, and environmental factors. Technological progress *per se* does not cause man-made climate change; it is technical-economic progress of a particular kind.

Erik Brynjolfsson and Andrew McAffe write in *The Second Machine Age* (2013) that: "Advances in technology, especially digital technologies, are driving an unprecedented reallocation of wealth and income."[43] In the absence of a detailed economic analysis--which these authors do not provide--this statement is nonsense. To begin with Brynjolfsson and McAffe do not define "technology". You cannot easily claim that "X" drives or causes "Y" if you do not know what "X" is. Secondly, for reasons described above, technical progress alone does not reallocate wealth and income. Improved computer hardware, software and networks would not drive increased disparities in wealth and income in the United States, for example, if we still had the highly progressive tax rates—91% for the top income bracket-- which existed after World War II. The problematic outcome these authors observe has much to do with the elimination of trade barriers and the globalization of the world economy, which, for Diesing, is economic "progress".

In Diesing's usage, technical and economic rationality are related, but not identical, forms of practical reasoning. Both are means-ends ways of thinking. Efficiency is the key value for both, although economists think about efficiency in a more abstract sense than do engineers.

Diesing's *Science & Ideology in the Policy Sciences* (New Brunswick, NJ: AldineTransaction, 2005), originally published in 1982.

[42] *The Nature of Technology*, p. 124.

[43] (New York: W.W. Norton, 2013), 128

Engineers, for example, attempt to build public works projects to specified quality standards at reasonable costs. This is what efficiency means to them. But for an economist, a completed, high-quality highway is not an end in itself. The real question is whether the highway will contribute to the overall efficiency of the regional transportation network over a given period of time; a high quality highway that is not used is worthless--or worse--because of its opportunity costs (foregone alternative uses of the money).

Technical/economic rationality may be understood in juxtaposition to the other types of rationality. Integration is the value associated with social rationality. If you and your wife are having marital problems, you are not likely to consult an engineer or an economist; you will see a counselor, a psychiatrist or perhaps a priest. You are not trying to make your marriage more efficient; you are trying to put it back together. This is primarily a matter of emotional commitments, not of money.[44] However, if counseling does not work, the two of you may hire lawyers. The lawyers will not put the marriage back together. They will work within a structure of laws (rules) to facilitate a divorce, divide up joint assets, and provide for custody of any children involved. Lawyers employ their own type of rationality, which is useful in managing conflict and disagreement, rather than solving it.

Political rationality is the rationality of decision-making structures, understood broadly to include informal or formal discussion roles, common beliefs and existing commitments. Political science is the study of decision-making structures.[45] Courts are the most formalized types of decision structures, which are particularly relevant to couples seeking a divorce.

The importance of the relationship between technical-economic progress and ecological balance is underlined by the growing popularity of the term "anthropocene," which refers to the present age, in which nature is undergoing substantial alteration as a result of human action. This period is usually dated from the invention of the steam engine in 1784, which accelerated technological innovations that led to urbanization, a tenfold rise in human population and the environmental problems (climate change, deforestation, new ocean chemistry, etc.) that have emerged in its wake. A key characteristic of the ecological perspective is that man is considered a *part* of nature, as opposed to the conception of nature as an enormous gasoline station at our disposal.

We suggest a simple, relational definition of the term technology: *"technical- economic systems of practical knowledge used to define and solve problems*".[46] Such systems are necessarily embedded historically in organizations, which exhibit functional rationality. In Diesing's framework, organizations are not tools or techniques, although they are often treated as such. Organizations have lives of their own. The March of Dimes did not shut down after Jonas Salk invented the polio vaccine. It simply found new goals.

Our definition of technology is *relational* in the sense that it fits into Diesing's structure of six types, and two aspects, of rationality. This avoids the confusion inherent in having each author, school or discipline invent his/her/its own terminology. We prefer to reserve the term "technology" for the technical/economic realm. "Methodology" seems more appropriate for social, legal, political and ecological systems. To be sure, there are "technological fixes",

[44] To be sure, there are combined problems. Diesing gives the example of a stressed-out married couple living with in-laws because they do not have enough money to get a place of their own. This would be a combined socio-economic problem. See Diesing, "Socio-Economic Decisions," *Ethics*, 69.1 (1958), 6-7.
[45] *Reason in Society*, pp. 170-172.
[46] For some purposes, as described earlier, it may be useful to distinguish between technical and economic technologies.

where a technical means is used to deal with a non-technical problem, often with mixed results. The birth control pill is one example of a technological fix.[47]

In Diesing's usage, technical and economic rationality employ a means-end framework which does not exist in the same sense in the other types of rationality. Social, legal, political, and ecological rationality are different types of thinking because they represent different kinds of values and exist outside the means-end framework. Strictly speaking, there would be no social, legal, political or ecological technologies, although people often talk this way.

How problems are defined is crucial. Consider the apocryphal story of the son of a billionaire who asks an attractive woman if she would be willing to have sex with him in exchange for one million dollars. The woman, who has little money, considers the offer. She thinks of the income she could receive by investing this sum in the stock market, reasons that she could protect herself from disease by insisting that the man use a condom, and says "OK". Then man then asks if she would go to bed with him for twenty dollars. The woman, highly offended, says: "What do you think I am?" "That's already been established," says the man. "Now we are talking about price." In this situation, an issue of right and wrong (legal rationality) has been transformed into one of economic rationality. (Economists, it is said, know the price of everything and the value of nothing.)

We may conceive of Diesing's types of rationality as inflated balloons taking up all the space in a wooden box. If the air pressure in one balloon is increased, it will decrease the size of the other balloons. In an economically rational society, the size of the technical/economic balloons tends to increase at the expense of the others. The phenomenon of "sugar dating" in response to economic pressures is a real-world example of this process. "Sugar dating" blurs the line between right and wrong, which is to say it weakens the structure of rules which constitute legal rationality.

> As the cost of university has risen, so has the number of "sugar babies" who pay for it by selling companionship and sex to wealthy older men. Monthly pay for this is typically about $3,000. . . According to Seeking Arrangement, a firm based in Las Vegas, two-thirds of sugar-baby graduates have no student debt. [48]

Types of Progress

Technological progress is—obviously--not the same thing as progress in general. Recall the Voli textbook's definition of technology as "a system used by humans that uses knowledge and organization." Organizations are social systems. At a minimum, an organization like NASA involves technical, economic, social, legal, and political rationality. (Ecological rationality is probably involved, as well.) Funding NASA involves choices among alternative uses of public funds (economic rationality). NASA also needs to be concerned with the morale of its employees (social rationality). A successful shuttle launch could create a crisis of morale if it resulted in downsizing and the loss of jobs once a key objective had been achieved. Like all governmental organizations, NASA needs to operate within a structure of laws and regulations (legal rationality). NASA likewise needs an appropriate decision-making structure (political rationality). Finally, NASA must concern itself with both substantive rationality (getting a

[47] See Amatai Etzioni and Richard Remp, *Technological Shortcuts to Social Change* (New York: Sage, 1973).
[48] "Paying for College: A teaspoon of sugar," *The Economist*, June 20, 2015, 32-33.

particular mission accomplished) and functional rationality (maintaining the viability of the organization over the long run).

One of the advantages of Diesing's framework of types of rationality is that it compels us to examine combined, often entangled, problems. Engineers may suggest that a space shuttle launch be delayed for mechanical reasons, but an immediate launch may seem desirable for political reasons. There is rarely a simple explanation using a single type of rationality. Our chief focus, then, is not on technology's inherent imperfections, but instead on something deeper and irremediable: different types of rationality represent different values, which conflict with each other in real-world situations.

Efficiency is not everything. New technologies do not merely make—or lose—money for their organizations. They also become symbols of belief systems and ideologies. This is the realm of social rationality. George Ball encapsulates this point in his claim that the automobile is an ideology on four wheels.[49] Glen Jeansonne observes that cars are not simply means of transportation, but contributed to moral laxity and the loosening of parental authority. As the car replaced the parlor for courtship and sex, young people used it to smoke cigarettes, get away from parents, gossip with friends, and drink bootleg liquor. A juvenile court judge called the automobile "a house of prostitution on wheels." It has also facilitated bank robberies, insurance fraud, and theft.[50] Viewing cars simply as a means of getting from here to there is thus radically incomplete, and evaluating them normatively is unavoidably complicated. Similarly, Assa Doran and Robin Jeffrey, in *The Great Indian Phone Book* (2013), show how the cell phone has enhanced personal autonomy, altered the ways the nation's millions of tiny firms do business, challenged rigid social structures, facilitated terrorism and crime, and helped efforts against terrorism and crime – as well as expediting communications.[51] Whether such developments represent progress depends on one's point of view.

Different societies exhibit preoccupations with different types of rationality, which entail different notions of progress. Until quite recently, as portrayed in the film, "The Gods Must Be Crazy," the Bushmen of the Kalahari Desert in southern Africa used simple tools that had not changed for centuries. Their technology did not advance and their notion of property was undeveloped, for there was hardly anything that could be owned. In Diesing's sense, there was no economy. An economy requires exchange and scarcity, which did not exist in the Bushmen's world. Instead, the society of small families of Bushmen was dominated by social rationality, with its focus on integration. A Coke bottle dropped from the sky by an airplane pilot changed all this, creating scarcity. There was only one Coke bottle, and as the Bushmen discovered many uses for it, everybody wanted it. From this came conflict that altered the Bushmen's hitherto self contained and peaceful world. Family leaders came to call the bottle "the evil thing" and tried to destroy it.

Technical-economic "progress" affects different societies differently. Countries like the United States, in which the automobile is the fundamental means of transportation, tend to be more individualistic than Japan or Germany, for example, where systems of mass transportation are well developed. The direction of causation may also be reversed. Countries with collectivist values are likely to choose modes of transportation that facilitate the reproduction of their cultures. Of course, this is too simple. Cities in the United States like New York and Boston are dense; they were designed and developed before the advent of the automobile. Mass

[49] Quoted in Benjamin R. Barber, *Jihad vs. McWorld* (New York: Random House, 2003).
[50] Jeansonne, "The Automobile and American Morality," *Journal of Popular Culture* 8 (1974), 1-34.
[51] (Cambridge: Harvard University Press, 2013).

transportation makes sense for them. A low-density city like Houston is inconceivable without the automobile. Without zoning laws, its suburbs expanded like amoebas along the lines of the highways. Collectivist means of transportation like subways make little sense in such a context.

There are also different types of causation. At the most general level, a process of technical-economic rationalization tends to create cultures that value efficiency. This efficiency may strain social ties. Thus, in an urban metropolis where time is money, people walk fast, drive fast, even talk fast. People in villages or retirement communities, where social rationality is stronger, meander down sidewalks, poke along on highways, and revel in endless anecdotes – or so the cliché goes. At another level of causation, the introduction of specific technologies may generate a cascade of organizational disruptions, large and small, as Elting Morison described in his study of continuous-aim firing on U.S. Navy ships:

> From changes in gunnery flowed an extraordinary complex of changes: in shipboard routines, ship design, and fleet tactics. There was, too, a social change. In the days when gunnery was taken lightly, the gunnery officer was taken lightly. After 1903, he became one of the most significant and powerful members of a ships' company, and this shift of emphasis naturally was shortly reflected in promotion lists.[52]

Alvin Toffler highlighted a third variety of causation in his best seller, *Future Shock (1970)*.[53] He argued that the dramatic effects of technical-economic development resulted not simply from the introduction of new technologies in societies. Equally important was the speed of technological innovation, which made personal and social adaptation ever more difficult. It is not just that machines may be frightening and job-destroying; it is the disorienting speed of change that leaves us so vulnerable. In *Present Shock,*[54] tellingly subtitled *When Everything Happens Now*, Douglas Rushkoff takes Toffler a step farther. It is not that we find the future disorienting, he says, but rather that technology has altered our relationship to time itself, leaving us focused entirely on now. Investors and voters, for example, are preoccupied with short term results.[55]

The modern world necessarily contains all six types of Diesing's rationality and their associated values. However, technological-economic progress tends to emphasize some values over others. On the relationship between social and economic values, for instance, Diesing writes that in early 20th century India, a man receiving a job offer would think first about how accepting a new position in a different city would affect his family relationships; salary and career advancement would be secondary matters.[56] In the United States today, where economic values are stronger, salary and career advancement normally come first. Technical/economic

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[52] *Men Machines and Modern Times* (Cambridge, Mass.: M.I.T. Press, 1966), pp. 36-37.
[53] (New York: Random House, 1970).
[54] (New York: Penguin, 2013).
[55] Paul Diesing describes changes in conceptions of time during economic rationalization on pages 24-28 of *Reason in Society*. He writes: "Time, in economically advanced cultures, has become a commodity to be bought, sold, and produced like other commodities. People do not merely live through time; they 'spend' time. That is, they are conscious of a scarcity of time, and try to use their supply of it as wisely (economically) as possible. Time is scarce because alternative things can be done in it. . ."
[56] Diesing describes economic versus social approaches to a job offer in a distant city on pages 115-118 of *Reason in Society*. In India at that time, relatives are [were] "so much a part of the self that a decision to move is inevitably an integrative decision centering on the effects of the move on kinship relations. When a person decides to move it is not to advance his wealth or career but to escape from intolerable social conflicts". Diesing, p. 118, citing Gardner Murphy, *In the Minds of Men (1953), pp. 30-31*.

progress might exacerbate the problem by presenting the man with a job offer far from home, but technology might also alleviate the problem by making it easier to maintain contact with family and friends in distant places by Skype, for example, or e-mail. On a national level, countries like Saudi Arabia, in the name of regime stability, attempt simultaneously to pursue technical/economic rationality to achieve material progress, while trying to maintain social rationality by keeping associated Western values from corrupting their religion and way of life.

For Diesing, the types of rationality are primarily social processes, not individual strategies. Social rationality for him is almost entirely unconscious, as, for example, with nationalism. Germans went from being ashamed of their country, defeated and humiliated after World War I, to being proud of it under the Nazis, who fostered remarkable social integration by the use of propaganda, clever symbolism, terror, and the persecution of Jews.

If technology is basically the process of technical-economic rationality, what is progress in general? From Diesing's perspective there would be six types of progress since there are six types of rationality: technical, economic, social, legal, political, and ecological. These types of progress may or may not appear desirable in specific contexts, depending upon one's point of view. Technical progress may create wondrous robots, but the workers displaced may fail to see the wonder. Economic progress may improve the gross domestic product, but part of this may consist of synthetic collateralized debt obligations and credit default swaps, which contributed to the global financial crisis of 2007-2009.[57] Social progress may make life seem more meaningful, as individuals feel themselves part of a larger whole, but this larger whole may be violently bigoted, so that the consequences for outsiders may be destructive and evil. Legal progress may lead to predictable, formal conflict resolution, but it may also be coldly indifferent to calls for mercy or rigidly insistent on adhering to rules that have long lost their justification, such as mandatory minimum sentencing guidelines and the California "three strikes" law. Increased political rationality may improve decision making by incorporating a wide range of interests and policy options, but this requires compromises that some find distasteful. With respect to ecological rationality, Diesing wrote:

> What is needed is a systemic technology that is appropriate both to the needs and limits of the biosphere and to the human potential for creative work, in that order of priority. That sort of technology cannot be devised by specialists, but requires broad biophysical knowledge of systemic processes.[58]

Progress in general, with a capital "P", usually involves combining different types of rationality. In his article "Socio-Economic Decisions" [Ethics, 69.1 (1958), 6-7], Diesing gave the example of a young couple living with their in-laws because they could afford a place of their own and were experiencing marital problems as a result. He defined this problem as primarily social and secondarily economic. Diesing's solution involved integrative methodologies, supplemented by maximizing considerations.[59] Problem definition is also key to the negotiating methodology described in *Getting to Yes: Negotiating Agreement Without Giving in*, by Roger Fisher and William Ury .[60] In our terms, this product of the Harvard Negotiation Project shows

[57] See Bethany McLean and Joe Nocera, *All the Devils Are Here: the Hidden History of the Financial Crisis* (New York: Penguin, 2010).
[58] *Science & Ideology in the Policy Sciences*, p. 301.
[59] "Socioeconomic Decisions," p. 6.
[60] Roger Fisher and William Ury (New York: Penguin Books, 1981).

how to combine social, political and legal modes of rationality. It shows how to be easy on the people involved in a negotiation process (social rationality), how to focus on fundamental interests rather than on negotiating positions (political rationality), and how to translate these into a lasting written agreement (legal rationality). These combined decision-making methods were crucial in negotiating the Camp David Accords between Israel and Egypt in 1978.[61] These accords have played a major role in keeping the peace between Israel and Egypt for nearly forty years.

Progress with a capital "P" involves both substantial and functional rationality. It involves organizations as well as objectives. Former Secretary of Defense Robert Gates has written: "The Department the Defense is structured to plan and prepare for war but not to fight one".[62] Improved organization for fighting wars is one type of progress, although it might not be welcomed by everyone.

There is little doubt that progress exists in techniques and methods in many fields. But what about the social sciences? Diesing wrote in 1991:

> Some researchers will perceive definite progress since at least 1970: the decline of Keynesian fantasies, of functionalism, welfare state and peace research, and the rise of monetarism, public choice, microsociology, rational expectations, and supply-side and new institutional and Austrian economics.
> Others will find progress in the 1950s and 1960s, with pluralist behavioralism, Keynesianism, functionalism, institutionalism, symbolic interactionism, modernization theory, ethnomethodology and deviance studies.
> Who is right? Let him whose thought is uninfluenced by personality or social factors make the first judgment.[63]

Each of Diesing's types and aspects of rationality is an observable type of effectiveness with associated techniques or methodologies in a historical setting. How the different types of rationality should be combined in an urbanized, interdependent world is a value choice. Indeed, it is *the* value choice.

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[61] See Leslie Kaufman, "Roger D. Fisher, Expert at 'Getting to Yes,' Dies at 90", *The New York Times*, 27 August 2012. Egypt's fundamental interest was regaining sovereignty over the Sinai Peninsula. Israel's fundamental concern was security from the threat of a sudden attack. The solution was to return the peninsula to Egyptian control but to limit the number of troops and weapons that could be deployed there.

[62] *Duty: Memoirs of a Secretary at War* (New York: Vintage Books, 2015), 116.

[63] Paul Diesing, *How Does Social Science Work?*, pp. 362-363.