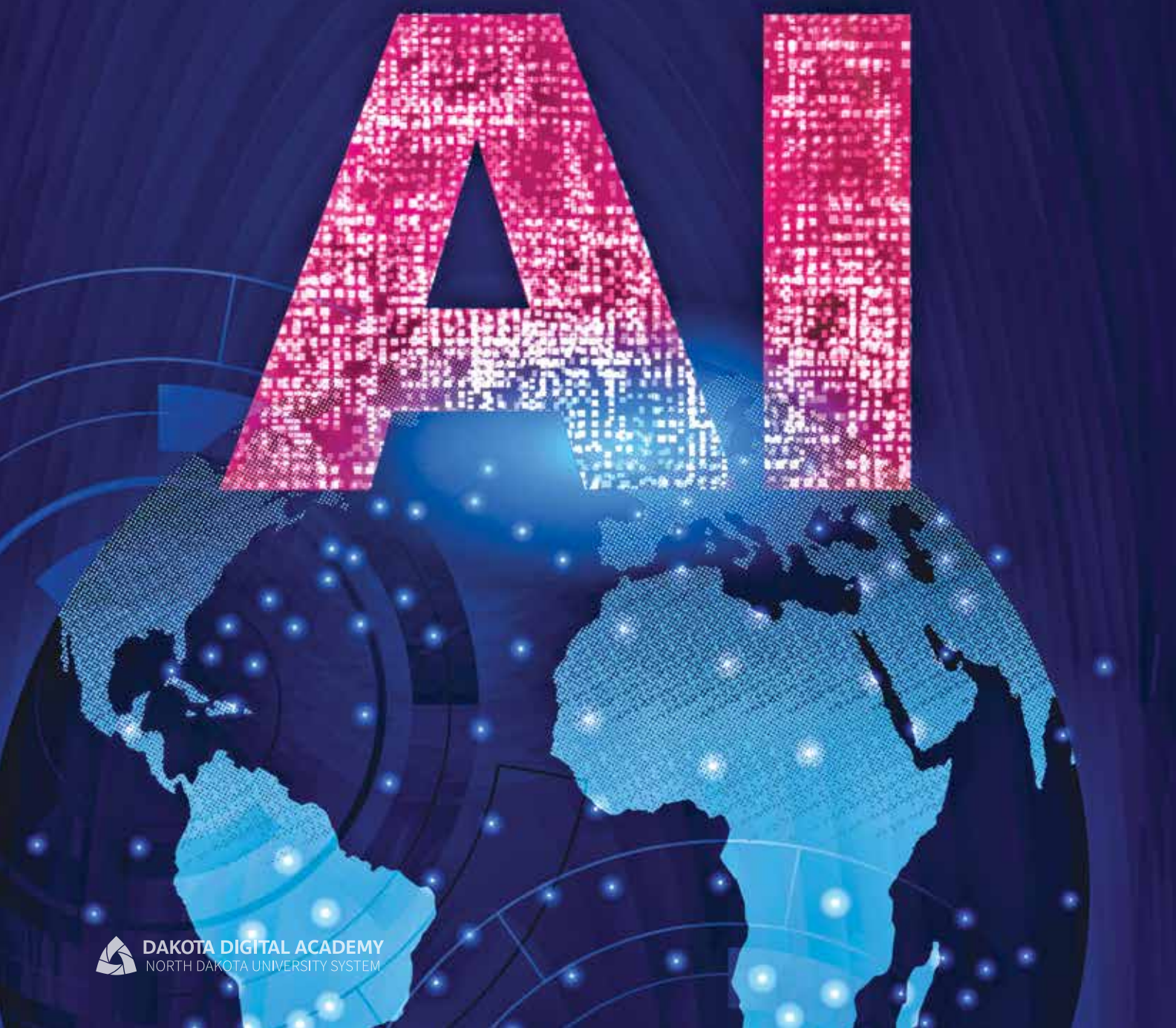
DAKOTA DIGITAL REVIEW

SPRING/SUMMER 2024



DAKOTA DIGITAL ACADEMY
NORTH DAKOTA UNIVERSITY SYSTEM

Introduction to the DAKOTA DIGITAL ACADEMY

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Digital technologies are transforming society and driving revolutionary changes in the world of work. In response, the Dakota Digital Academy (DDA) was founded by the North Dakota University System in the fall of 2020 to provide online education in computing and the cyber sciences. DDA serves students at higher education institutions across the state—as well as residents in the workforce seeking to upskill or change careers—by imparting relevant digital skills. To date, we have focused primarily on courses and certificate programs in cybersecurity and software development.

DDA works cooperatively with the state's 11 public colleges and universities, which include two research universities, four regional universities and five colleges. Also affiliated are North Dakota's five tribal colleges. Talented faculty across the state system work together to design and deliver location-agnostic workshops, full courses, short skill-specific courses and certificate programs. Some activities are oriented toward improving the skills of technical people already in the workforce. Others focus on continuing education and credentialing for K-12 teachers.

Also included in DDA's instruction are soft skills related to the liberal arts, such as teamwork, creative and critical thinking, problem-solving, ethics and communication, along with considerations of technology's social implications.

Over the last three and a half years, DDA successfully launched Dakota Digital Review, Dakota Digital Discussions and the Workforce Advisory Council, which is comprised of business, industry and government leaders who support DDA's workforce readiness and cyber-educational mission.

Going forward, DDA is pursuing several highly relevant initiatives. One focuses on digital literacy in general education across the university system. Gen Ed refers to suites of required courses imparting knowledge and skills fundamental to all major fields of study and to success after graduation. Increasingly today, literacy in computing and cyber sciences constitute essential components of every student's formation.

A second initiative concerns advancing education in artificial intelligence and machine learning—including content creation systems such as ChatGPT, which are revolutionizing and disrupting nearly every industry, and augmenting or supplanting functionalities that involve reasoning, perception and creativity, which have been strictly human domains throughout history. ▣

■ *Dakota Digital Discussions Webinar Series*

Dakota Digital Discussions is a webinar series presented in the fall and spring semesters by Dakota Digital Academy and Dakota Digital Review. The webinars focus on the digital transformation of our economy, military and society, as well as digitization's profound ethical, legal, cultural, educational and policy implications, including impacts on the arts and humanities and the human psyche. Most Dakota Digital Discussions engage for an hour and are scheduled at noon Central.

Please access upcoming and archived webinars at: https://dda.ndus.edu/ddd-overview/

DAKOTA DIGITAL REVIEW

- **Dakota Digital Review** publishes articles, in print and online, about digitization and related technologies, as well as digitization's profound implications for our culture, economy, military, political institutions and policies, legal frameworks, moral foundations, and the arts and humanities.
- **Dakota Digital Review** is non-partisan, dedicated to free speech and academic freedom. The articles are written by subject experts in business, industry, government and academia for the general educated reader.
- **We aim to better prepare** students, faculty, fellow residents, and business, community and political leaders to make the critical decisions about our collective future and about our individual and family lives.
- Please contact Patrick J. McCloskey, Editor, Dakota Digital Review, for submissions, comments or questions: **patrick.mccloskey.1@ndus.edu.**

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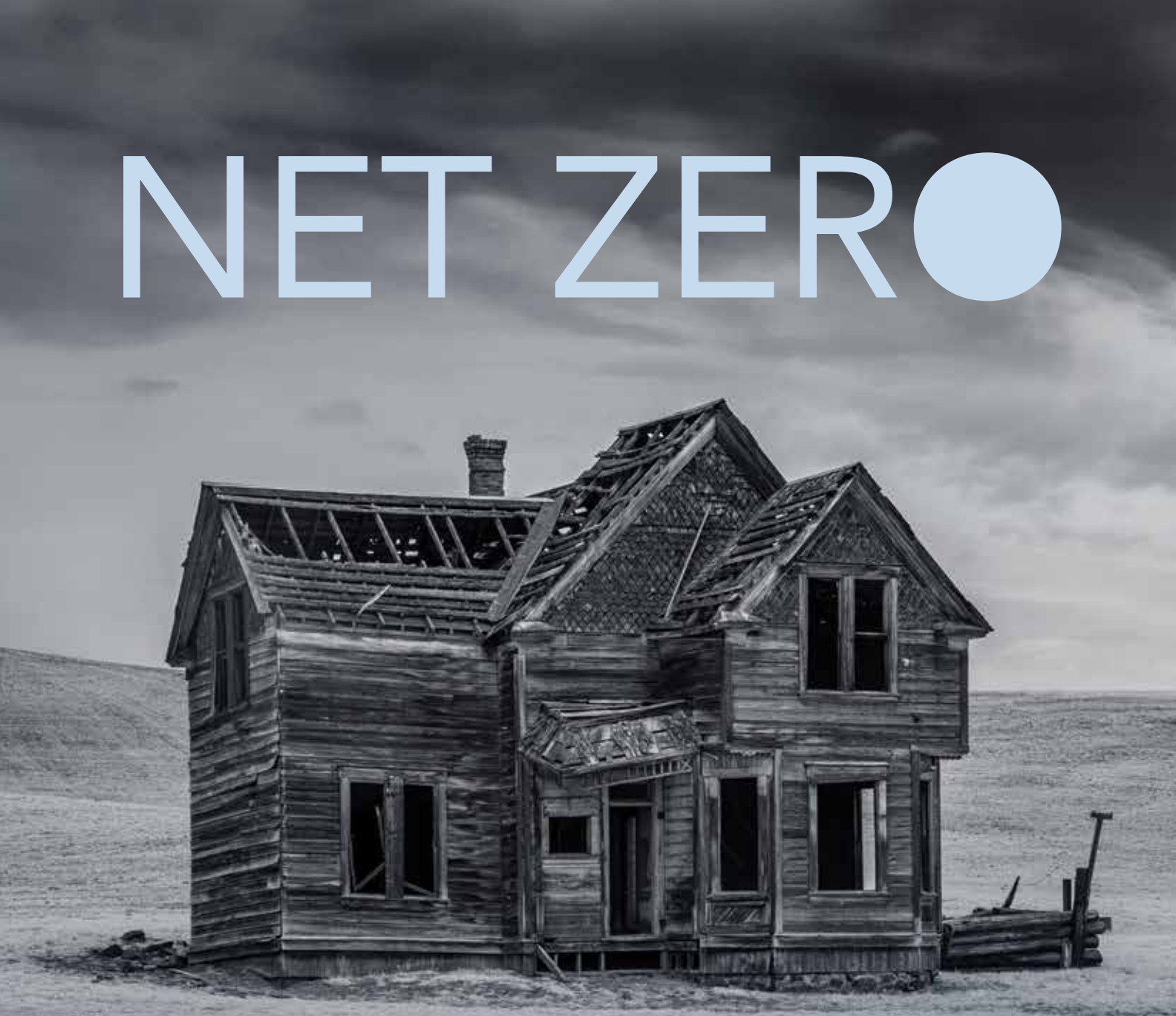
NET ZERO



MARK P. MILLS
Director, National Center for Energy Analytics, Distinguished Senior Fellow at the Texas Public Policy Foundation

Curious minds may wonder if the phrase "net zero" was cooked up by media consultants to evoke the Coke Zero brand, something nice, desirable and merely a choice. The net-zero branding has certainly worked, not only captivating the green-energy punditry but, more importantly, it has deeply and dangerously infected energy policymaking and government spending.

Given the ubiquity of the term, it hardly seems necessary to define it, but "net zero" is, to put it simply, the proposed yellow-brick road to an

PATH TO ZERO GROWTH

energy future that is carbon-free. Massive spending programs and mandates are now planned in the pursuit of converting net-zero PowerPoint aspirations into the hardware needed to power society in order to replace hydrocarbons—oil, natural gas, coal—that today fuel everything, including digital infrastructures, that make civilization possible. But no imagination is needed to understand why Barclays Bank, for example, recently doubled down on an oath of fealty to the net-zero vision; it is because, as they wrote, there could be "trillions of dollars to finance."[i] It's unsurprising to find that bankers 'follow the money.'

There's no secret as to why so many policymakers have engaged in the most expensive and ambitious intrusions into industrial policy in the history of free nations. The net-zero path is focused on an "energy transition" that would eliminate the use of hydrocarbons because combusting them necessarily creates carbon dioxide (CO2).

Transitionists imagine that legislative and fiscal manipulations will make it possible to simply choose carbon-free energy, much as one can simply choose a calorie-free Coke. Not to dwell on the branding analogy, but there's no small irony in the fact that, just as calories are required for survival (though far less so, sugar calories), so too is CO2 required for life on earth since that molecule is to plant life what oxygen is to animal life.

Of course, it also hardly seems necessary to point out that the entirety of the great climate debate is the claim that humanity is putting too much extra CO2 into the "one atmosphere" we all share. There is no dispute that humanity is adding CO2 to the globe's far more massive natural fluxes of CO2. And, even though there is no scientific "consensus" about the magnitude or even nature of effects from those additions—despite vigorous assertions to the contrary, the science is, in fact *Unsettled*, in the words of the title of physicist Steven Koonin's book[ii]—one doesn't need any knowledge or convictions about climate change in order to explore and understand the realities of energy production. They are different magisteria, to borrow a scientific construct from the late great biologist Stephen Jay Gould. Beliefs and forecasts about the future climate have nothing whatsoever to do with understanding the underlying physics, engineering and economics of machines that produce and use energy.

Indeed, we know far more, with much more certainty, about energy-producing domains than we know about atmospheric sciences. Thus, regardless of the fraught climate debate, one can explore both the prospect for and the consequences of the now monomaniacal pursuit of an "energy transition" away from hydrocarbons, including in particular: Is it even possible, at least in the time frames imagined?

From Embargo to "Transition"

History offers some lessons. In a time long ago, in 1973-74, before the internet and before the first cellphones roamed the earth, the U.S. and the world were subjected to the first modern "energy shock" with the infamous Arab Oil Embargo. That political event caused oil prices to vault by over 300 percent during the first quarter of 1974, which in turn triggered a global recession. Imagine the fallout today were such a price hike to happen.

Meanwhile, even though the embargo was a political event, policymakers back then somehow concluded that the world was in danger of running out of oil and thus enacted, both then and serially thereafter, legislation and massive spending programs to find ways to replace oil. It was the first modern quest to stimulate or accelerate an energy transition.

The result? Over the half-century since then, global consumption and production of oil increased by 12 billion barrels a year, along with an even greater overall rise in global energy use. Coal and natural gas use also increased, even more in energy-equivalent terms. The reason? Economies and populations grew and drove energy demand up faster than any alternatives to hydrocarbons could emerge and scale up to fulfill.

Energy Demands

Understanding how energy demands occur in the first place is critical to gauging the consequences of tinkering with or constraining the availability of—or increasing the costs of—energy.

Energy demands start with the basic fact that every product or service invented, built and operated necessarily starts with mining primary materials somewhere. The global mining industry alone accounts for about 40 percent of all industrial energy use, and it runs almost entirely on hydrocarbons, especially oil.

Then those primary materials are converted, in energy-intensive processes, into the building blocks of the infrastructures of the modern era. A pound of polymers, used in everything and especially in medical domains, requires some tenfold more energy than a pound of wood, the latter still used today, but that was for eons (with stone) the dominant infrastructure material. Similarly, a pound of semiconductor silicon takes 100 times the energy to produce as a pound of steel. The world has no more moved beyond the

Cars lining up at an American filling station during the 1973 Arab Israeli War, when members of the Organization of Petroleum Exporting Countries (OPEC) imposed an embargo in retaliation for the U.S. decision to resupply the Israeli Defense Forces.

use of steel than the use of wood, but the invention of digital communications and computers led to entirely new kinds of infrastructures. Global economies now spend nearly $1 trillion a year each on all three inputs, steel, polymers and semiconductors.

Once machines are built, there is then, self-evidently, energy used to operate them. Put in economic terms: Every $1 billion of cars purchased leads to about $100 million a year in fuel purchases; every $1 billion of aircraft drives the need for about $250 million in annual fuel purchases; and every $1 billion spent building datacenters leads to about $800 million a year in electricity consumption. Global businesses invest trillions of dollars every year building those types of machines.

The purpose of all that spending is not intended to create energy demand, but to provide services people want and like. In the ideal world, the availability and cost of energy to fuel all machines would be trivial and could be taken for granted. The economic relevance of energy costs is most easily seen in transportation domains. In a low-energy cost world, the share of a product's final price, arising from transportation, ranges from as little as 5 percent (for lightweight things like electronics) to 25 percent (for heavy things like glass). Double the cost of energy, and the price of all products becomes inflationary.

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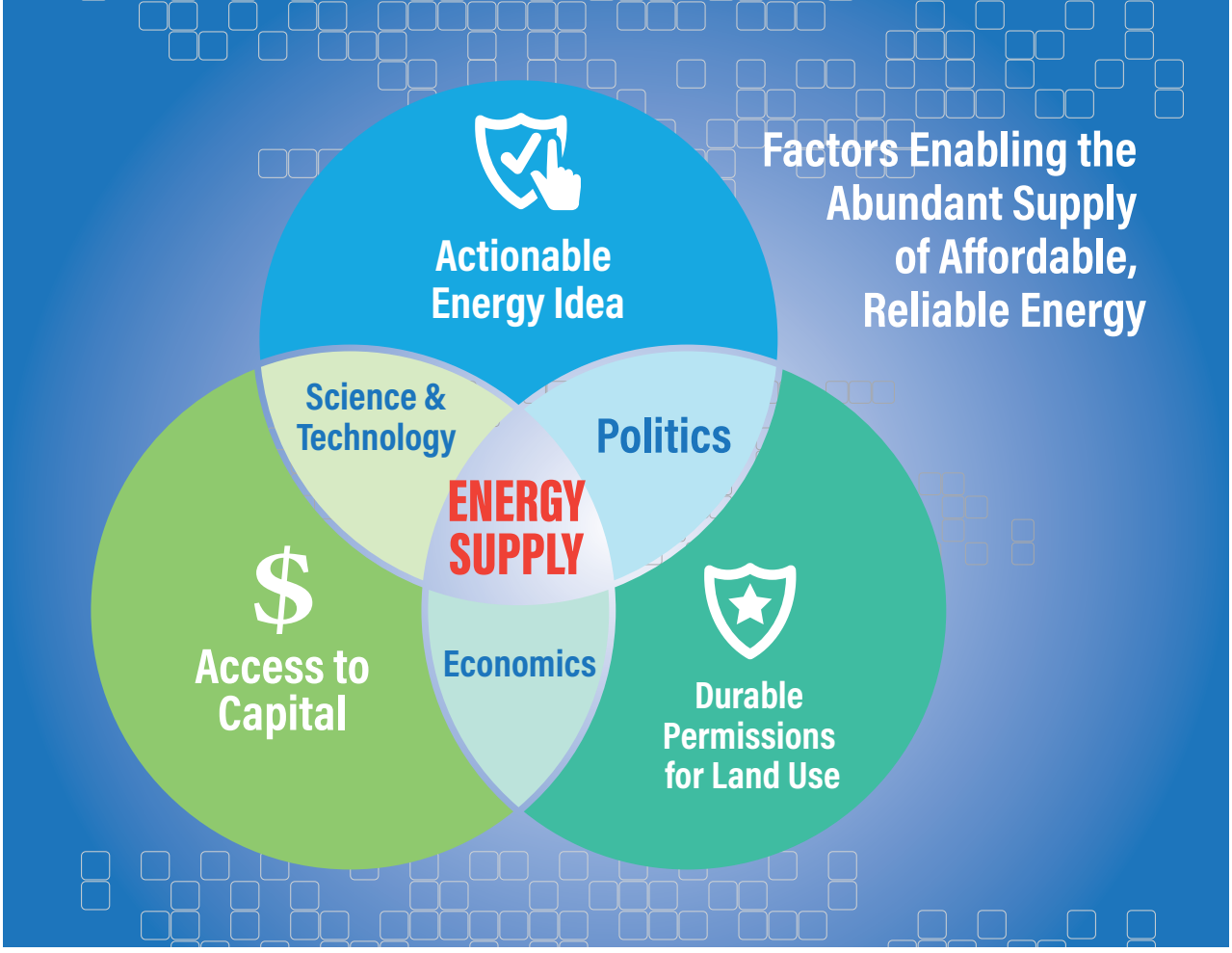


Energy Efficiency & Abundance

When it comes to the realities of energy demands and to the higher energy costs created by transition policies, a common response from the energy punditry is to invoke improving efficiency to simply reduce demand. Obviously, more efficiency reduces the energy costs of using a specific product. But history shows that lowering costs to produce or use a product, with rare exceptions, leads to a greater number of products sold and greater use of those products.

The energy cost of illumination has dropped some ten-thousandfold since the days of whale-oil lamps. But the quantity of illumination delivered to humanity has increased some one-hundred-thousandfold and, thus arithmetically, there's been huge increases in the amount of energy society devotes to producing lumens. Similarly, a 300 percent decrease in airline energy use per passenger-mile over the past three decades brought with it a nearly 1,000 percent rise in total passenger-miles flown, leading to a huge increase in overall aviation energy use. And the astronomical drop in the energy cost of computing has taken that sector from a functionally non-existent energy-using domain to one now rivaling aviation.

[H]istory shows that lowering costs to produce or use a product … leads to a greater number of products sold and greater use of those products.

Engineers have many more 'tricks' to yet deploy in pursuit of superior efficiency. But there are billions of our planet's inhabitants who have yet to become wealthy enough to afford to buy or use very much of

what the so-called "developed" nations now enjoy. If only half the world's less fortunate eventually use one-fourth as much energy per capita as Americans, global energy demand doubles. There is, it needs to be said, a kind of iron law of global energy demand: It will rise. Thus, a central social challenge for the future remains the same as for the past, ensuring energy abundance.

The ability to supply enough affordable, reliable energy to society is determined at the intersection of three realities: first, having an actionable idea about what it takes to build some kind of energy-producing machinery at civilization scales; second, having access to capital (energy is unlimited, capital isn't); and, third, having durable permissions, since all of nature's energy forms require access to land, and thus permissions, to locate the energy machinery. This means that real-world energy solutions are inherently multidisciplinary, involving science, technology, financing and politics.

Commercial Timelines

Popular media—clickbait in the social media era—and much rhetoric in policymaking circles are preoccupied with energy ideas without appreciation for realism. Of course, there are new ideas and innovations when it comes to machines that produce or use energy. But a key feature of all the ideas proffered as "solutions" is the amount of time it takes to achieve commercial viability at civilizational scales.

The idea of a battery using lithium chemistry dates to the mid-1970s, but it didn't reach commercial maturity for small applications for two decades, and then it took another decade to see manufacturing maturity at scale. The idea of uranium fission dates to the early 1900s, but commercial viability at scale took over a half-century to even begin. The same pattern is visible across the entire energy landscape. Today's photovoltaic cells were first instantiated as an idea 75 years ago, and far better ideas are still needed for solar electricity to scale to global significance. For context, the hundreds of billions of dollars spent on solar and wind machines so far are supplying, combined, under 4 percent of all global energy. While there is ample evidence in the technical literature of foundationally superior photovoltaic technologies, there is no evidence that the timelines from new ideas to scale are significantly accelerating.

Net Zero vs Energy Additions

Which brings us to the putative energy transition in search of net zero. History shows that when it comes to sources of energy, transitions don't happen; additions do. Wood, society's oldest energy source, still supplies threefold more global energy than does the combined output from all wind and solar hardware. Even in the U.S., wood-for-fuel is today at roughly the same level of consumption as in 1824. The "transition" that has occurred has been a huge decline in the share of supply for a far bigger economy.

Nowhere is that reality—understanding additions and shares—more starkly clear than with the preoccupation of many policymakers to mandate electric cars to cut oil use (and thus reduce CO2 emissions). Even if half of all the world's cars (instead of today's two percent) use batteries instead of engines, it would displace barely more than 10 percent of all petroleum use. That's neither an existential threat to "Big Oil" nor an energy transition.

Over the last half century, the arrival of additional sources of energy, from nuclear to biofuels, to the expansion of hydroelectric dams as well as wind turbines, has left unchanged the overall per-capita global use of hydrocarbons. As for the future, even the wildly unrealistic forecasts for alternative energy from the International Energy Agency (IEA) see a world in 2050 that still gets over half of all energy from hydrocarbons. That's lower than today's 80 percent but that wouldn't be close to zero.

$200+ Trillion Quixotic Quest

The challenges faced in effecting a wholesale energy transition have been brutally highlighted in the fallout from the war in the Ukraine. It's instructive to see just how difficult it has been for Europe to delink from Russian natural gas, a transition that entails a tiny fraction of the quantities of energy contemplated by the net-zero punditry. The most important single factor for Europe in replacing Russian gas, other than economic contraction, has been the massive increase in imports of U.S. liquified natural gas (LNG). The realities of replacing hydrocarbons can be illustrated: Matching the energy flows from a single new $2 billion LNG terminal would require building instead

$60 billion of wind turbines, and natural gas would still be needed when the wind isn't blowing.

In general, there is a fantastical naiveté to thinking it's possible to achieve the scale of construction needed to "accelerate" to net zero. Taking the world from today, where just over 80 percent of all energy comes from hydrocarbons, to zero by 2050 would require building and installing every day for 30 years the equivalent of roughly one thousand of the 3 MW Washington-monument-sized wind turbines. It's no wonder that the BloombergNEF (Bloomberg's green-energy research team) transition advocates point out that something like $200 trillion of capital will be needed to build machines in pursuit of a transition.[iii]

A lot of that money will be spent before policymakers come to terms with the single biggest roadblock to transition aspirations. The world is not producing, nor planning to produce, the necessary quantities of underlying minerals to build the 'green' machines. Delivering the same energy to society compared to hydrocarbons—using wind and solar, and EVs—would require a 400 to 7,000 percent greater use of critical minerals, in particular copper, nickel and aluminum, along with minerals such as graphite, neodymium and manganese.

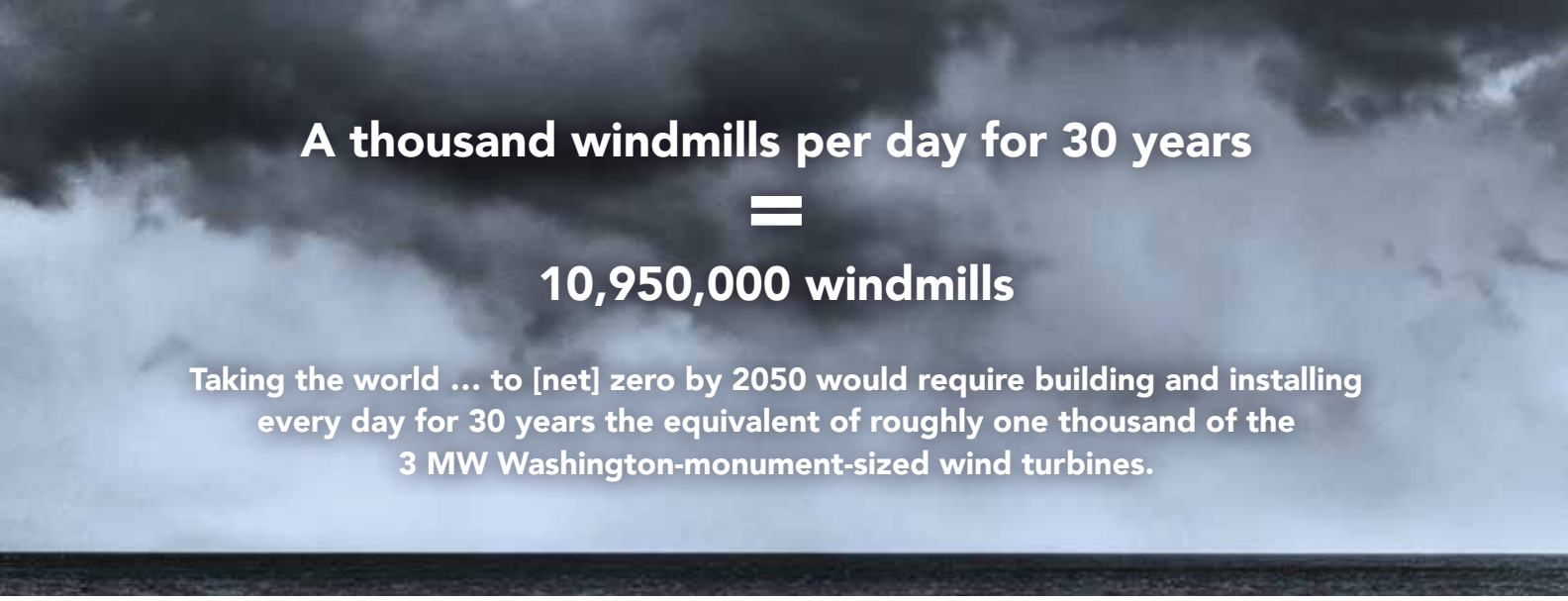
And that increase in demand understates the ultimate materials requirements if the goal is to entirely replace hydrocarbons that are otherwise to be relegated as back-up for dealing with the vicissitudes of wind and sun. The variable nature of the sun and wind is about more than daily and seasonal variations, but also the fact that over the decades, time periods that grids are designed to operate, it is meteorologically certain that there will be many periods of days-long solar or wind "droughts." In theory, those can be managed by building lots of excess capacity and lots of energy storage. But that in turn means far more capital and far more critical "energy minerals" will be needed.

Mining, Materials Famine & Inflation

Meanwhile, as the spending on transition aspirations continues, those policies will end up creating a metals famine. As noted earlier, the transition machinery entails mining and processing energy minerals at unprecedented scales. Not only is the global mining industry not expanding apace, but instead, the data show spending underway and announced for new mining capacity is in decline.

Thus, we have some irreconcilable forecasts. Copper, for example, is the single most important metal for the electrification desired in the transition. But based on existing and announced mining plans, if the demands to build EVs alone actually materialize, the world will face unprecedented shortages of copper. This says nothing about where copper and other energy minerals are refined. The epicenter for that is China, and China's market share of refined energy minerals is roughly double OPEC's market share of oil. Policymakers are only now starting to come to terms with the associated geopolitical and pricing risks.

Meanwhile, to imagine we can fill the gap with mines located in the U.S. runs counter to what's happening. It's not just that it takes a decade or two



to open a new mine, but that the current federal administration is working hard to make it far harder, not easier, to open or operate a mine here. The opposition to mining is spreading around the world too, and not by accident but by design. Opposition over "equity" issues in Panama last year, to note just one example, led to the cancellation of expansion plans at one of the world's biggest copper mines and its shutdown, temporary for now.[iv]

If the politically driven demand for far more minerals continues, it will stimulate a classic lesson in Econ 101 regarding demand rising faster than supply. That always leads to higher prices, something miners and their investors will appreciate, and something that eventually stimulates more supply. There is a cabal of forecasters who point to such "market forces" as inevitably solving the supply problem. There is, after all, no question that sufficient resources exist in the Earth's crust.

The mining industry has a long history with the challenging balance between prices staying high enough, long enough for the long period of enormous capital spending needed to build new mines. That dynamic creates a natural tension between suppliers and consumers, the latter preferring lower costs, but higher costs experienced long enough lead to consumer revolt. Thus, it's relevant to note that economists at the International Monetary Fund (IMF) analyzed the minerals supply shortfalls that the "transition" pursuits will create for the various classes of energy minerals. The IMF concluded that such pursuits will trigger history's highest- and longest-run inflation in mineral prices. All this will happen at the same time as other government policies and central banks seek to tamp down inflation.

The CEO of Ivanhoe, one of the world's biggest mining firms, recently attached a stark number to that dynamic, noting that the supply-demand gap could induce a tenfold hike in copper prices specifically. If copper prices spike to such levels, that would inflate all manner of goods, especially the costs of upgrading electric infrastructures, which are necessarily copper-based, and it would add $10,000 to the cost of each EV.

Faced with the irreconcilable intersection of demand and supply for minerals, many energy pundits claim technology can dig us out of that hole by making batteries, wind turbines and solar panels more efficient; that would, by definition, reduce the quantities of input materials needed. Vastly superior battery chemistry—that is, more energy stored per pound of material—by definition reduces the amount of primary materials that are required. It is reasonable to assume that innovators will indeed create and pursue superior technologies, reducing the quantity of materials needed in the first place and also bringing greater efficacy to mining. But there are a couple of caveats: timing and limits.

Scaling Energy vs Computing Systems

An over-used and misused adjective associated with aspirational energy technologies is to expect "exponential" progress for "energy tech," both implicitly and explicitly, invoking analogies with the

pace of progress seen in computing and smartphones. But only in comic books do energy systems scale the way information systems do. The underlying physical chemistry of the best lithium batteries available, for example, entails about one-tenth the inherent energy density of petroleum. That gap can't be closed with subsidies for yesterday's technologies. Instead, what one sees in the real world is incremental, not exponential nor radical, progress with manufacturable technologies, including and especially large-scale batteries.

But it's true that there are well-known bench-top chemistries that are twice as good as today's commercial batteries—half as much material needed per unit of energy stored. However, not only does that still leave a yawning gap for minerals supplies (recall that the transition will drive a 400 to 7,000 percent increase in demand for various minerals) but new, better technologies take time to scale up, often decades. For context, today's lithium batteries began the path to commercial viability circa 1980, but it was 30 years before the first Tesla S sedan emerged, and it's taken another decade to scale to EVs produced at some significant level, even if still a trivial share of all vehicles.

In the theoretical world of chemical science, there is visibility for the potential for batteries to match the energy density of combustion chemistry—the two domains are scientific cousins after all. But none of the theoretical possibilities have yet seen a "lithium moment" deserving of a future Nobel Prize. As Bill Gates properly said, such classes of scientific/technological discontinuities have "no predictor function." Thus, the future "exponential" class of innovations, while possible, are entirely irrelevant for what can be planned for and built in the coming couple of decades. The same is true across the entire pantheon of energy technologies, 'green' or otherwise.

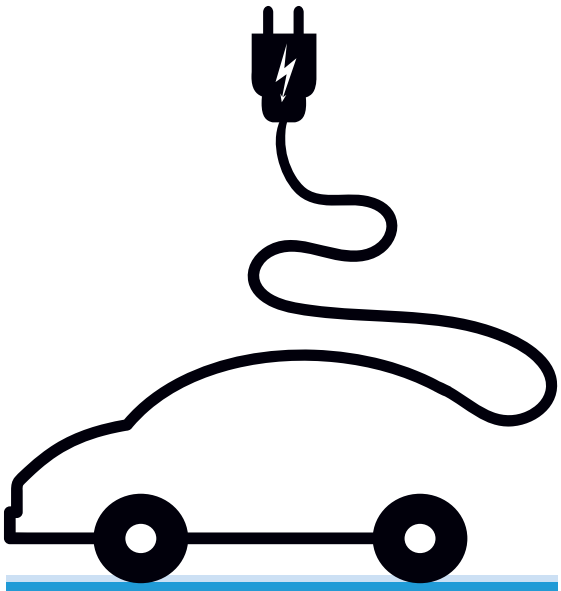
What happens in the real world is that machines we know how to build eventually approach the underlying physics and engineering limits, not least with regards to the availability and costs of input materials. That's roughly where the state-of-the-art is with all energy-producing machines that operate at global scales, whether conventional or so-called alternatives. But now, with the rising cost of capital needed to build hardware at scale, we see that real-world costs of energy delivered by solar and wind have been rising faster than for conventional machines—the former by some 200 percent over the past five years—because using the sun and wind requires more capital and more hardware (and more land) to replace the same energy delivered by hydrocarbons. That the underlying resources—sunlight, wind—are "free" is completely irrelevant. Wood, coal, petroleum and natural gas are all free. It's the machines (and permissions) that cost.

No Net-Zero Machines

In addition to capital, a significant part of the cost of all machines, especially 'green' machines, is in the energy used to acquire, move and refine the raw materials to build the machines that subsequently harvest nature's energy. This means that building 'green' machines entails a significant upstream cost in terms of CO2 emissions. In the pantheon of facts that are informative about the realities underlying the transition narratives, the energy emissions associated with building wind turbines, solar panels and EVs (never mind fueling them) mean that there are no such things as "zero emissions" machines.

While exact magnitudes of upstream CO2 emissions are difficult to document for any specific machine—the data occupying this domain are classic "known unknowns" depending on where and how the underlying materials are mined and refined—the range of facts are well-known. When it comes to EVs, the poster-child technology for the transition and the locus of hundreds of billions of dollars in subsidies, obtaining the materials and fabricating the batteries can generate a quantity of CO2 emissions that rivals the lifetime emissions of a conventional car burning oil. In other words, EV emissions merely occur somewhere else on the planet. And this says nothing about the array of other environmental and social challenges associated with mining to fabricate the EV.

There's another ignored fact regarding those upstream emissions; they will rise in the future, not decline because of the centuries-long trend of declining ore grades. A lower concentration of metals in the rock—the ore grade—means that the next ton of minerals



[O]btaining the materials and fabricating the batteries [for EVs] can generate a quantity of CO2 emissions that rivals the lifetime emissions of a conventional car **burning oil. In other words, EV emissions merely occur somewhere else the planet.**

needed will entail far more rock dug up and processed leading to more energy use and thus more emissions to get the same future ton. This geological reality is true for essentially all metals.

Stranded on the Yellow-Brick Road

Many of the transitionists acknowledge many of these realities about mining, manufacturing and construction, and thus propose that far more aggressive measures are needed to reduce CO2 emissions, measures directed to reducing behaviors that consume energy in the first place. For example, as the IEA proposes, those in the wealthy developed nations should reduce the amount of air travel, capping the number of flights for vacations and business; induce or mandate that houses be kept colder in the winter and warmer in the summer; convince consumers to return to clotheslines instead of dryers; and reduce overall private car use requiring instead more ride sharing, slower speeds and banning sales of conventional engines.

It is true that such behavioral changes would reduce energy use and emissions. But it is also true that there would be political and social consequences from trying to ensure that such behaviors are adopted, whether by mandates or by "inducements" through taxes that make energy more expensive. Some of the public pushback is already evident, not least in various European nations that are further down the "yellow-brick road" leading to the emerald-green transition.

Growth, Innovation & Energy

Finally, the single biggest impediment to achieving a "transition" to a future free of hydrocarbons is the unavoidable fact that economic and population growth is always fueled by rising energy consumption. The magnitudes of what economists called "unmet demand" are devilishly difficult to predict because they arise not just from more energy demands created by more people and more wealth using more of the technologies that already exist (something reasonably forecastable), but they also come from the invention of new technologies that eventually become widely used.

Foundational innovations are always associated with an eventual significant expansion in overall energy use. It is self-evident there was no energy used for flying

The International Energy Agency's global pathway to net zero by 2030 requires annual investment to increase from $2 to $5 trillion to produce 7 percent less energy, using an area equal to India for wind, solar and bioenergy.

Energy Policy Research Foundation

or driving or computing before the inventions of commercially viable machines to perform those tasks. In the cloud-era of computing, that sector's energy use now rivals global aviation. The implicit and deeply flawed notion in long-term energy forecasts—and long-term is the core *métier* of transition forecasters—is that there won't be any more foundational inventions leading to new products and services.

History shows that humans have far more capacity to invent new things and ways to use energy than new ways to produce it. Economists have a miserable record of anticipating foundational innovations, even though there are no limits to imagination. The implications of which lead to the obvious conclusion that the energy future will be, necessarily, one of "all of the above" wherein we'll see additions to, not transitions from, hydrocarbons.

For evidence of the implications of the iron linkages between growth and energy, we can look at the predictable outcomes from recent policy aspirations. The U.S. is deploying billions of dollars in subsidies to reshore manufacturing without a commensurate investment in the necessary expansion of energy and especially electricity supply, nor considering that such are necessarily dependent on low-cost energy. If the U.S. were able to restore manufacturing to the same share of global production as in the year 2000, the resulting increases in domestic CO2 emissions would roughly match all the decreases hoped to come from spending on alternative energy. And this says nothing about the private sector's rush to invest in artificial intelligence (AI) and the collateral expansion of cloud infrastructures. AI is the single most energy intensive use of silicon in history. The cloud today, before the infusion of energy-intensive AI, already uses roughly tenfold more electricity than all the world's 30 million EVs. In energy terms, AI computing is equivalent to putting semitrailers on highways instead of Mini Coopers.

The future will see increased energy use to power those and other infrastructures. That will lead to an acceleration not deceleration in society's overall wealth which, consequently, means an increase in energy use. The question of how we fuel cars in our near future will be roughly as consequential as thinking in terms, circa the 19th century, about how to feed horses.

One of the greatest, perhaps the greatest of human achievements has been the transition away from a time when, for most of history, 50 to 80 percent of all economic activity was devoted to acquiring fuel and food, collapsing to below 20 percent today for developed nations. That was made possible by the arrival of the age of hydrocarbons. That transition allowed the wealth of nations to be reallocated to other pursuits, those of comforts, conveniences, education, entertainments, better health and safety, and of course the modern luxury of minimizing humanity's overall impacts on our environment. ▣

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[i] https://home.barclays/sustainability/addressing-climate-change/

[ii] https://www.barnesandnoble.com/w/unsettled-steven-e koonin/1137483249

[iii] https://www.bloomberg.com/opinion/articles/2023-07-05/-200-trillion-is-needed-to-stop-global-warming-that-s-a-bargain

[iv] https://news.mongabay.com/2023/11/panama-copper-mine-to-close-after-supreme-court-rules-concession-unconstitutional

CBDC vs BITCOIN

PRIVACY & FREEDOM OR TOTAL CONTROL?

MARCUS FRIES, PHD

Associate Professor of Mathematics, School of Applied Sciences, Dickinson State University

On April 10, 2020, there was a transfer of 161,500 Bitcoins (worth $1.1 billion USD at the time) from one account to another. This transaction was completely anonymous and took approximately 10 minutes. The total fee for this transfer was about $0.68.

This transaction highlights one of the major advantages of cryptocurrency, the ability to transfer large sums quickly at low fees completely anonymously. It was later revealed that this was a transfer by an exchange to refill one of the exchange's accounts for trading. Until the owners of the exchange came forward, there was only suspicion, but no proof, of either the sender or receiver.

In this article, I will go over the fundamental properties of money/currency, and then compare and contrast the advantages and disadvantages of cryptocurrency (Bitcoin, in particular) and a central-bank digital currency (CBDC).

PROPERTIES OF MONEY

We all depend on money on a day-to-day basis to pay our bills and for our employers to pay us. But little thought is given to the abstract properties of money that make it so useful. Let's go over these properties to see how they apply to both the U.S. dollar and Bitcoin.

Money needs to be *fungible*, that is, able to be exchanged equivalently, which we see in our current dollar system. One U.S. dollar bill may equally be exchanged for another, likewise, a current $100 bill is the same as any other $100 bill (except for exceptions of collectability). This does not hold true with all things that can be exchanged for goods and services.

In barter days, one could trade a sheaf of wheat for a few eggs. But not all sheaves of wheat are equal. Even if we impose a weight requirement, the quality of the wheat could vary from sheaf to sheaf. So, while sheaves of wheat could be used in exchange for goods and services, they were not fungible as different sheaves have different values.

Another example of a fungible object is precious metals given by weight and purity. A one-ounce silver bar at 0.999 percent purity is equivalent to almost any other such bar. This is why historically metals made a good currency. We will see they satisfy several other properties of money as well.

Money should be a *store of value*. U.S. bills are made from special materials to make them more durable. Precious metals, especially the so-called *noble metals* such as silver, gold, and platinum, make a great store of value. They maintain their weight and purity through most situations. In contrast, sheaves of wheat are not a great store of value as they can be damaged quite easily and require very specific storage to maintain their quality. But no matter how careful you are, the sheaf of wheat will eventually decay.

Money should be *portable*. U.S. bills are quite light and many of them can be easily transported by an individual. Even amounts in excess of $10,000 are not difficult to transport. Precious metal coins also are easily portable as their value-to-weight ratio is quite high. Though transporting a significant amount of say silver does pose a challenge. On the other hand, sheaves of wheat are not very portable.

Money should be *highly divisible*. U.S. currency is highly divisible as it can be divided down to the penny, which in fact has a higher value of metals than the actual currency value. Precious metals are also highly divisible as quantities down to dust can be made, weighed out and exchanged. Sheaves of wheat are divisible down to individual stalks and eventually grams of flour.

Money should be *rare*. The amount of U.S. currency in existence is highly controlled by the Federal Reserve. While the actual value of the physical materials of the bills is low, the "scarcity" of the bills helps maintain their value. Precious metals are also rare. The total amount of gold in the world currently is approximately 210,000 tons. Sheaves of wheat are not regulated in the amount that could be grown, except by the amount of arable land in existence.

Lastly, money should possess the *single spend* property. We want an individual unit of money to be spendable by an individual only once. Physical currency has this property. We need to ensure this property for digital currency.

PROPERTIES OF MONEY SATISFIED BY BITCOIN

Bitcoin was designed with the fundamental properties of money in mind. It is fungible, in that one Bitcoin is the same as any other. It is a store of value in that one Bitcoin will always be one Bitcoin. Its value relative to other forms of money may change, but that happens with all currencies around the world. It is portable; all you need to access your Bitcoin is your password. It is highly divisible with the smallest division of one Bitcoin allowed by the network is 0.00000001 Bitcoin. This makes it much more divisible than standard U.S. money. Bitcoin was designed with rareness in mind and is produced through a process called *mining*. The total amount that will ever be mined is 21 million. This means there will always be a limit on Bitcoin, making it rare by its very nature. Transactions are grouped

into *blocks* and transactions for accounts are tracked against account balances. This is how single spend works with Bitcoin.

WHAT IS BITCOIN?

Bitcoin is essentially a ledger keeping track of account numbers and balances that is broken into pieces called "blocks" making up a "blockchain." The account numbers are the only thing associated with a balance; there is no other information on identity. So, the only one to know exactly who owns any particular Bitcoin is the account holder, who also possesses a secret code that allows him or her to initiate transactions.

Bitcoin is maintained by individual users supplying computing power to a joint network. To initiate a transaction, an account holder sends the following information to the network: (i) a source account, (ii) a target account, (iii) an amount of Bitcoin, and (iv) a "signed" copy of the transaction. The signature is related to the secret key kept by the user. The transaction is then sent to the network and placed into the current block.

To form the blocks of the blockchain, the Bitcoin network collects all transactions approximately every 10 minutes and then uses this information in that time period from the previous block to create the new block. Mathematical operations, called "hashes," are performed that turn this data into a number. (The important factor about a hash is that it's very difficult to produce two different blocks with the same hash. As a result, faking a single transaction changes the hash, invalidating the transaction.)

The network then sets about the search for a "nonce," a number used only once. The properties of this number are that when included in the hash of the previous block and all transactions since that block was mined, the resulting hash has a set number of leading zeroes. This nonce is unique to the block, since it is the number that results in a certain number on the output. Since it is not known how to predict the output of a hash, this step is done by brute force (exhausting all possibilities, which by current computing power would take years). The number of leading zeroes is adjusted as the computing power of the network improves. The machine that finds this nonce is then awarded a number of Bitcoins, according to a predesigned schedule. This process is known as mining. The result of the mining process, finding the nonce and hashing the transactions, form a block, the next in the chain. This protocol is called a "proof-of-work" system and is the core of several cryptocurrencies, as well as Bitcoin.

It's important to note that the process of mining is distributed across many users around the world. This makes Bitcoin *decentralized* in that there is no central authority certifying transactions. The security comes from the fact that the blockchain is difficult to replicate. If a malicious actor wanted to fake or erase a transaction, he or she would need to supply a fake blockchain. This would require more computational power, from more users or more computers, than is currently allocated to the Bitcoin network.

A second crucial point is that since account owners are known only to the account owner and not the network, if the secret key is lost or fraud occurs, there is no recourse for the user. There are many instances of secret keys being lost, worth millions of dollars. These Bitcoins are not recoverable, they are simply lost.

CBDC PROPERTIES

CBDC also satisfies the properties of money, outlined above. Their main differences from Bitcoin are that, first, account numbers are associated with personal identification information, that is, some institution, such as a bank, knows to whom the money belongs. Secondly, if designed properly, CBDC money is recoverable upon loss of the secret key. Lastly, there is fraud protection with a CBDC, in contrast to Bitcoin's anonymity, which lacks this capacity.

CBDC will have single spend, fungibility, high divisibility and rarity. The rarity will come from the central issuing bank controlling the supply.

One difference with CBDC is that the blockchain will be controlled by either the central authority or by participating banks.

CBDC vs Bitcoin

CBDC	Bitcoin
No anonymity from central authority	Complete anonymity
Solid security	Complete security
Fund recovery upon losing secret key	No recovery upon losing secret key
Protection against fraud	No protection against fraud

There is another scheme for creating blocks in a blockchain that is called "proof of stake." This is where entities allocate any amount of the currency to the blockchain network. Then random stakeholders are chosen for validation of the blocks based on an algorithm that makes larger stakeholders more likely to be chosen. This then creates the new block and ledger system of the network.[i] The cryptocurrency Ethereum currently works on a proof-of-stake system, in which users allocate an amount of Ethereum to the network and then a random account is chosen, with probability based upon the amount of Ethereum pledged, to create the new block in the Ethereum blockchain.

PRIVACY CONSIDERATIONS

Some privacy advocates express concern in that all CBDC transactions are recorded. Every payment made to any person is identified on both sides by personally identifying information. While this allows for recovery of funds and fraud protection, some privacy advocates believe that it gives too much control to the central authority. They believe that this control could be used to deny funds to those with whom the central authority disagrees.

Contrast this with Bitcoin that has total privacy but absolutely no protections except security and perceived secrecy.[ii]

CONCERNS OVER CBDC

Many people view CBDC as the next step on a slippery slope toward control of individual lives and beliefs. Last May, Gov. Ron DeSantis signed a law banning the use of CBDC in Florida with the aim of "protecting the personal finances of Floridians from government overreach and woke corporate monitoring."[iii] Gov. DeSantis, who was running for president at the time, declared, "We will nix central-bank digital currency if elected." Robert F. Kennedy, Jr. has echoed the governor's concerns. They have

both pointed to the system emerging in China, where digital currency is linked to the social credit system.

They fear that CBDC could be utilized for continuous observation of every individual's spending. Further, they worry about the potential of total control, for example with automatic enforcement of limits and restrictions on what everyone can buy. Lastly, there are fears that if an individual or group were to be viewed as "unfavorable" by the government or other powerful organizations, they could be debanked, that is, cut off from all banking services.

The current banking system already allows for much of what CBDC opponents fear: All transactions are already tracked, especially debit and credit cards. Already, a bank can cut you off from your funds, although this is currently illegal.

> **"It is well enough that people of the nation do not understand our banking and monetary system, for if they did, I believe there would be a revolution before tomorrow morning."**
>
> **– Henry Ford**

However, a CBDC could be developed that would greatly increase surveillance and control by enabling instantaneous monitoring of all transactions and complete real-time control over each individual's spending habits.

Yet, according to Peter Zeihan, an acclaimed geopolitical consultant and best-selling author, to implement a totalitarian CBDC would "require several acts of Congress to be akin to the current Chinese system."[iv] Accordingly, CBDC proponents argue that it would take several bad actors in government, breaking the law, to carry out what opponents fear. And if this occurred, Congress and the courts would act to uphold the American justice system. Further, Congress could pass legal and regulatory safeguards.

The author of this article believes that many of the fears voiced by CBDC opponents are valid but could be addressed through proper design. At this point, no official articulation of a CBDC has been put forward. If the Federal Reserve Board of Governors, which constitutes our nation's central banking system, were to develop a CBDC, they could and should involve designers of several of the existing cryptocurrencies to provide a blend of securities—that is, the privacy of Bitcoin with the recoverability of credit cards, such that the currency cannot be programmed to "shut off" for particular purposes.

Yet, the only truly secure and private method of transaction is cash currency. But as with Bitcoin, there are no protections. It can be lost or stolen without much chance of recovery. Further, if you are defrauded there is not always a ready recourse.

Regardless of what happens, the author contends that digital currencies are here to stay and that if the U.S. doesn't develop one, we will fall behind the rest of the world in banking and commerce, since CBDC allows for instantaneous digital transactions between individuals; between individuals and merchants; between business, including banks and large international corporations; and within and between governments. ▣

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[ii] https://arstechnica.com/features/2024/01/how-a-27-year-old-busted-the-myth-of-Bitcoins-anonymity/

[iii] https://www.axios.com/2023/05/15/desantis-war-on-cbdcs

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IMAGINATION

Path to Artificial General Intelligence

ATIF FARID MOHAMMAD, PHD

The rapid development of artificial intelligence (AI) in recent years has inspired new visions of our future, many of which are being developed by Big Tech and thousands of startups worldwide. Now, artificial general intelligence (AGI) beckons as a thrilling and challenging frontier to explore, offering many possibilities and transformations across most industries.

AGI can be defined as the creation of machines that possess the ability to understand or learn any intellectual task that a human being can do. However, there is no strict definitional consensus. Some experts, such as Sam Altman, CEO of OpenAI, describe AGI as "AI systems that are generally smarter than humans."[i] Still, simply put, AGI is a machine's capacity to perform tasks and solve problems with a level of cognitive ability comparable to—or exceeding—human intelligence.

AGI encompasses various abilities, such as reasoning, learning, problem-solving, perception and language understanding. These capacities enable an AGI system to be versatile and adaptive, granting it proficiency in diverse, wide-ranging tasks, without needing explicit programming for each one.

AGI's promise lies in the ability of digital systems to help humanity solve its most complex challenges. Environmental degradation, income inequality, drug discovery, space exploration, material science, food production and mental health are areas in which AGI can make significant contributions.

However, it's unclear how to create an AGI-capable system.

Narrow AI vs AGI

A crucial distinction is between AGI and Narrow AI (also known as Artificial Narrow Intelligence or ANI).[ii] ANI, which we currently possess, excels in specific tasks or domains, while lacking the versatility of human-like understanding or adaptability across multiple tasks that would characterize AGI.

Examples of narrow AI include language translation algorithms, facial recognition systems and self-driving vehicle technologies. These AI systems are designed for a specific purpose and cannot perform tasks beyond their designated domains. In contrast, AGI aims to equip machines with the cognitive flexibility to apply their intelligence widely, emulating human-like strategic thinking and problem-solving, which are required to resolve complex issues.

The concept of AGI can be traced back to the early days of AI research in the 1950s. AI's founding fathers—John McCarthy, Marvin Minsky, Allen Newell and Herbert A. Simon—believed in the possibility of creating machines that could perform any intellectual task a human could. The term "artificial intelligence" was coined to describe machines or systems "exhibiting behavior at least as skillful and flexible as humans."[iii]

Since then, AI research has mainly focused on creating ANI systems, producing many successful and transformative specialized AI applications. Achieving AGI has remained the ultimate goal but has proven more elusive than initially anticipated. Recent advancements in deep learning, neural networks and reinforcement learning have rekindled the hope of progressing towards AGI, but there is still a long way to go.

Convolutional Neural Networks

One of the most widely used methods in image processing and analysis is the Convolutional Neural Network (CNN). Inspired by the visual processing

mechanisms of the human brain, CNNs excel in tasks such as facial recognition by learning to identify patterns through training on large datasets.

A typical CNN consists of an input layer, multiple hidden layers and an output layer. The input layer receives arrays of picture pixels, while the hidden layers, composed of "neurons," utilize mathematical operations to extract features from the image. These hidden strata include, among others, convolution, pooling and fully connected layers.[iv]

The convolutional layer is usually first to extract features from an input image. Once the image passes through the hidden layers, it hits the output layers, which classify and deduce results from the image processing.

Key AGI Approaches & Techniques

Various methodologies have been proposed to develop AGI, including:

- **Reinforcement learning** is an approach in which an AI agent (software) interacts with its environment and learns to achieve its goal through trial and error, guided by a reward system.
- **Deep learning** is a subset of machine learning (ML) that employs artificial neural networks to learn hierarchical representations of data, thereby enabling computers to perform tasks with minimal human intervention.
- **Knowledge-based systems** involve a symbolic approach that uses formal rules and logic to represent and manipulate knowledge, allowing machines to reason about complex problems.
- **Evolutionary algorithms** are a class of optimization algorithms, inspired by natural evolution, that uses techniques such as selection, crossover and mutation to solve optimization problems.

Challenges & Limitations

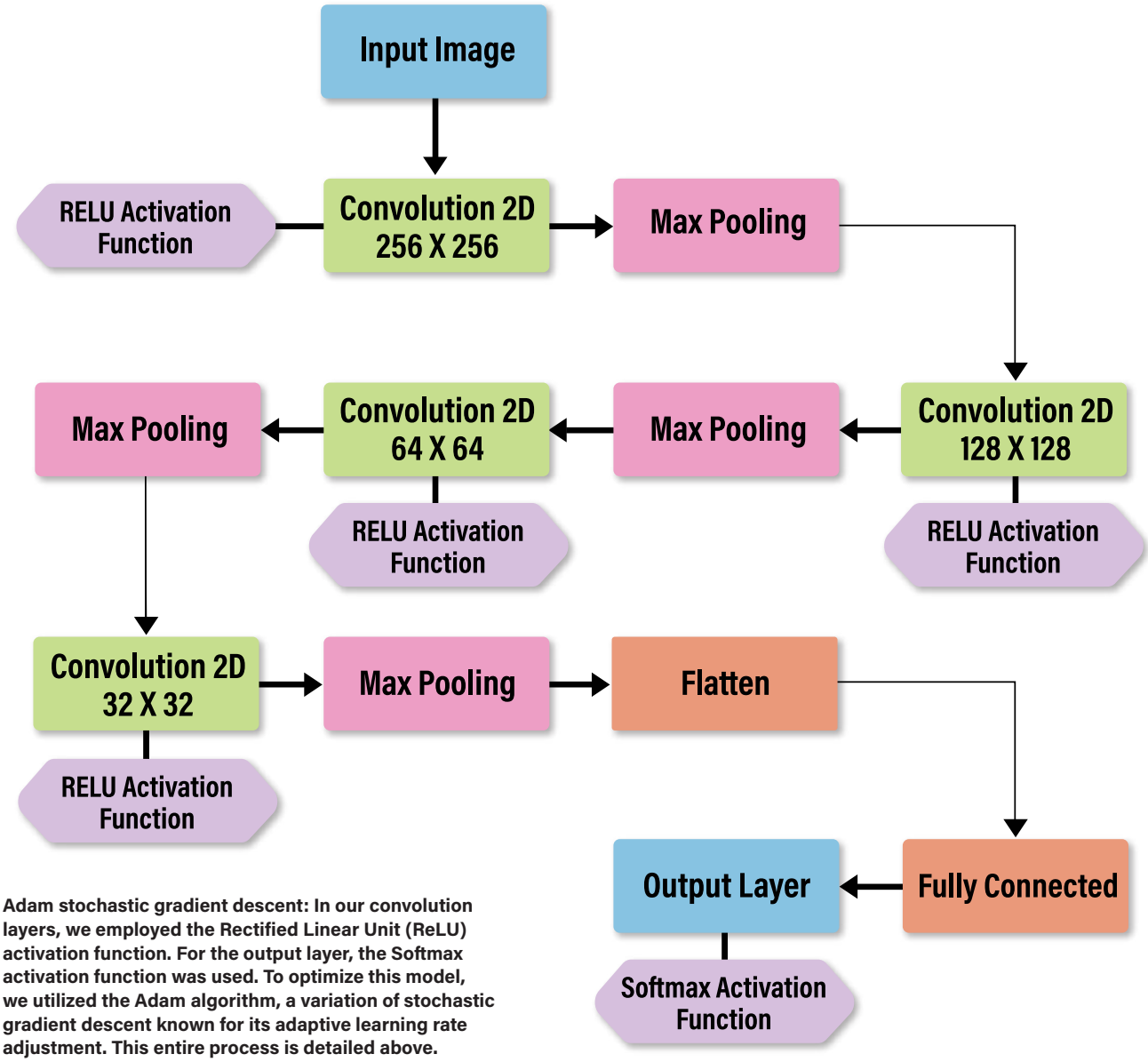
Despite promising advancements in AI research, several challenges must be addressed before AGI can become a reality. Some of the most significant include:

- **Scalability:** Developing an AGI system that can scale its learning and understanding across multiple domains, tasks and environments remains a significant hurdle.
- **Transfer learning:** AGI requires the ability to transfer knowledge from one domain to another, a feat that remains challenging for current AI systems.
- **Explainability:** As AGI systems become more sophisticated, understanding the decision-making process behind their actions becomes increasingly crucial yet difficult.
- **Resource constraints:** Developing AGI requires vast computational resources, posing a challenge to those with limited access to cutting-edge hardware and expertise.

As mentioned above, CNN architecture consists of input and output layers, along with multiple hidden layers. CNNs are designed to detect patterns within the whole image, which are crucial for calculations such as classification. In this analysis, we utilize four convolutional layers. Images, in any format, are processed through the first convolutional layer where they undergo max pooling, which selects the brighter pixels, and then are converted into the 128x128 pixel format size. Then these images are sent through the second convolutional layer where essential features, such as facial geometry points, are extracted, again by applying max pooling. The final convolutional layer resizes these images into the 32x32 pixel size and converts them into arrays to accelerate measuring the distances between illuminated pixels to make the images recognizable by the human eye.

Breakthroughs & Milestones

Although AGI has yet to be achieved, some notable breakthroughs in AI research have inched us closer to realizing this goal. For example, large language models (LLMs), such as OpenAI's GPT-4, Meta's Llama 2 and NVIDIA's Megatron-LM, which generate human-like text, have demonstrated impressive abilities in multiple language tasks.



Adam stochastic gradient descent: In our convolution layers, we employed the Rectified Linear Unit (ReLU) activation function. For the output layer, the Softmax activation function was used. To optimize this model, we utilized the Adam algorithm, a variation of stochastic gradient descent known for its adaptive learning rate adjustment. This entire process is detailed above.

The capabilities of LLMs are hugely impressive and continue to improve daily. Now, OpenAI is developing and releasing integrations that will allow its language models to interact with other applications and the internet in general. This will bring new and exciting capabilities across a variety of industries—especially health care, transportation and finance—and will influence a renaissance in web technologies and scientific research.

In *The Singularity is Near: When Humans Transcend Biology*, Ray Kurzweil discusses linear versus exponential growth. He describes the concept of "knee of the curve," the point at which growth rapidly increases and the change from linear to exponential growth is observed.[v] The launch and widespread use of LLMs will mark the turning point where technological innovation moves from linear gains to exponential gains. As more users have access to capabilities that they would not normally have, they will be able to rapidly develop solutions and collaborate with others to achieve even more than they otherwise would alone.

DeepMind's AlphaGo and AlphaZero programs have showcased expert-level gameplay and self-learning in competitive board games. These milestones provide valuable insights into the potential capabilities of AGI, inspiring further research and development.

Potential Applications of AGI

The successful development of AGI could revolutionize almost all industries and professions, accelerate scientific discovery and contribute to solving complex global challenges. This section highlights the transformative potential of AGI across different domains.

Transforming Industries and Professions

AGI could significantly impact industries such as healthcare, finance and manufacturing, by offering innovative solutions and streamlining processes. For example, AGI systems could assist physicians in diagnosing and treating complex medical conditions, help financial analysts find optimal investment strategies, or revolutionize supply chain management by optimizing production and logistics.

Advancements in Scientific Research

One of the most intriguing aspects of AGI is its potential to accelerate scientific research and discovery. AGI systems could assist researchers in finding groundbreaking solutions to long-standing problems—for example, harnessing nuclear fusion that would provide the world with limitlessly clean and self-sustaining energy—as well as providing innovative ideas and techniques to various scientific fields, such as physics, chemistry and biology.

Solving Complex Global Problems

AGI has the potential to help humanity address some of its most pressing challenges, including environmental degradation, poverty and inequality. By providing new insights and solutions, AGI could contribute to more sustainable policies, resource management and equitable distribution of knowledge.

Ethical Considerations & Implications

AGI development raises serious ethical concerns revolving around its alignment with human values, potential misuse and governance.

AGI Alignment with Human Values

As we develop AGI, it is critical to ensure alignment with values that serve humanity's interests. Researchers and developers must prioritize the safe and responsible design of AGI technology, incorporating fairness, transparency and inclusiveness to minimize potential harms and maximize benefits.

As AGI advances, the power, autonomy and rationality of AGI systems will increase and approach goals that may risk misalignment with positive human values and create new conflicts of interest. To moderate this, it is crucial to develop methods to control and influence AGI's decision-making processes. AGI could be used for malicious purposes as already shown with ANI applications, such as surveillance systems that infringe on privacy rights.

The power of AGI comes with the potential for misuse, and it is crucial to consider how to safeguard against unintended consequences and malicious exploitation. Establishing strict security protocols, fostering international collaboration and devising robust countermeasures are crucial measures to mitigate the risks posed by AGI.

Ensuring responsible use requires robust safeguards and regulations that should be developed with international regulation, shared legal frameworks and comprehensive oversight to prevent deployment that causes harm to human individuals, institutions or societies.

LLMs

A critical aspect of this journey involves the evolving capabilities of large language models (LLMs). While the advancements in LLMs and other generative AI systems are impressive and continue to improve, they have significant environmental costs. For instance, "training GPT-3 in Microsoft's state-of-the-art U.S. data centers can directly consume 700,000 liters of clean freshwater, and the water consumption would have been tripled if training were done in Microsoft's Asian data centers."[vi]

Of even greater concern, "[c]ompanies began sounding the alarm about data center power consumption five years ago at the annual Hot Chips semiconductor technology conference by predicting that worldwide compute demand could exceed the total world electricity power generation within a decade."[vii] For a thorough analysis of AI's energy usage, please refer to "AI's Energy Appetite: Voracious & Efficient" in the Fall/Winter 2023 issue of Dakota Digital Review.[viii]

Generative AI workloads will increase as more individuals, organizations, businesses and government agencies identify its value. Different approaches to building AI and AGI systems will need to be developed to ease water and energy consumption.

Debate on AGI Regulation & Governance

To ensure the responsible and ethical development of AGI, there is an ongoing debate surrounding its regulation and governance. Policymakers and AI researchers must engage in a continuous dialogue to create comprehensive frameworks and policies that balance innovation with ethical concerns, thereby guiding the future of AGI in a manner that benefits humanity.

AGI will undoubtedly change the nature of work as it currently exists today. Research suggests that in five to 20 years, a third of jobs could disappear because of LLMs.[ix] Lawmakers and governments worldwide will have to carefully study the impact LLMs have on the employability of its citizenry, so that a strategy is put in place to address the resulting disruption. A basic starting point could be the creation of state-funded, job-retraining programs that identify individuals affected or displaced by AGI and LLMs.

Corporations and governments will also have to come to terms with the capabilities and limitations of AGI—as examples, rapid preprocessing of large datasets and the challenges of data dependence in establishing the contexts needed for comprehension—to ensure that safeguards are in place to prevent models from producing damaging content that promotes discrimination, hatred and violence. This will require careful collaboration between business and government to ensure that legislation and regulations safeguard the public yet do not stifle innovation.

Looking forward, a hypothetical AGI system called Dishbrain might prove very helpful, harmless and honest, for example, when used as a personal assistant. Its broad intelligence could revolutionize everyday life as it learns from vast online datasets, offering customized advice, managing schedules and even providing emotional support. While its applications in education, healthcare and creative fields are promising, responsible development and user control are crucial to guard against bias and manipulation and to ensure alignment with principles beneficial to humanity. ▣

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CRYPTOCURRENCY SCAMS: WHAT TO WATCH FOR

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Cryptocurrency scams continue to increase. According to the Federal Trade Commission's fraud reports, cryptocurrency scams totaled over $1.4 billion in 2023 alone.[i] In my capacity as Director of Digital Forensics Services at Dakota State University, the cryptocurrency scams described below occur too commonly today. The names in these accounts are fictional, but the stories are real.

Investment/Romance Scam

Michael had always wanted to invest in cryptocurrency, which he found interesting but didn't know where to begin. One day, a woman on Facebook named Isabella direct messaged him to start a friendly conversation. Soon flirtation blossomed, moving from the social media site to messaging privately on WhatsApp. As they learned more about each other and their relationship deepened, Isabella eventually shared that she'd made money investing in cryptocurrency.

Isabella offered to teach Michael what she knew, providing a link to a site where he could purchase cryptocurrency. It appeared that Michael's money was going into a wallet held on the Coinbase Exchange. However, unknown to Michael, the link Isabella provided wasn't really to Coinbase but to a fake site. Initially, he made a small investment, which appeared to make significant gains. He made a few small withdrawals and, encouraged by the results, he invested larger and larger amounts. Michael invested most of his life savings and then watched as his money quickly tripled in value.

When Michael wanted to withdraw some of his money, he was informed that his account was frozen due to suspicion of money laundering and insider trading. Confused, Michael reached out to Isabella who also seemed confused. Michael then began receiving emails saying he had to pay a retainer fee to prove that he

wasn't insider trading. Panicked, Michael again messaged Isabella who pleaded with him to pay the fee so she wouldn't lose her money as well.

Michael paid the 10 percent fee of the balance of his account and then received another email stating that he now owed a fine. Michael realized he'd been scammed but continued communicating with Isabella. Eventually, he began to realize she too was not real. When Michael last checked his account, the balance was $0.

Tech Support Scam

Linda was browsing through Facebook one day when a popup screen appeared, and a blaring sound came from her speakers. The popup message claimed her computer was infected with a virus and she needed to call for technical support. Concerned, Linda called the number on the screen and talked to Gabriel, who acted very helpful and explained that her computer protection was out of date. Linda's computer was quite old, and she knew little about technology. So, she trusted Gabriel who instructed her how to give him remote access to her computer.

After a few hours, Gabriel fixed Linda's computer and said her new protection would cost $299 and that he would call the next day to check on her. Linda provided Gabriel with her debit card information and believed her computer was fixed.

The next day, Gabriel called to make sure the computer was running smoothly and let her know she would be getting a $299 refund because after checking his records, he discovered she had previously had some protection on her computer. Gabriel then popped open a screen on Linda's screen that appeared to be her bank account with the refund and an additional $50,000.

At this point, Gabriel seemed to panic and yelled at Linda saying she needed to return the money, or he would lose his job. She said she would get him a cashier's check, but he insisted on cash, saying a

cashier's check would take too long. Linda refused to send cash and helplessly watched as Gabriel zeroed out her account on the screen before her. She screamed for him to return her money, so he returned the money in the accounts on her screen and said she needed to go to the bank to get $25,000 today and another $25,000 the next day to send to him.

It seems the reason she was targeted by the scammers was that they found her financial records and knew she had at least $50,000 in her account. As part of the tech support scam, they had access to her computer, then looked for and located her bank statements.

Linda lived in a small town, and it was late in the day, so the local bank was closed, forcing her to drive for miles to get cash. Gabriel then convinced her to drive five more hours to deposit the cash in a town with a Bitcoin ATM. Acting kindly, he walked Linda through the steps to deposit $25,000 into his crypto wallet account. He stayed on the phone with her the entire time, through the long drive and while she deposited the money.

The ATM would only accept $15,000 per day so Gabriel instructed Linda to return home, then he would call her in the morning to help her deposit the rest. He stayed on the phone with her the entire drive home and insisted she tell no one.

The next morning, after talking with her husband and then her local bank, Linda realized what had happened and did not answer Gabriel's call. He called repeatedly and finally giving up after 13 attempts. In total, Linda lost $15,000.

Warrant Scam

One day, Steve got a call seemingly from his local sheriff's office saying his warrant needed to be paid immediately, or he was going to be arrested. The caller-ID number on Steve's phone indicated it was from the sheriff's office. He didn't want to be arrested, so he followed directions, went to a local cryptocurrency ATM, deposited cash and sent the funds to the requested wallet address. He brought the receipt to the sheriff's office as requested, only to find out that he'd been scammed.

Same Story, Different Method

These three stories have one thing in common: scams involving cryptocurrency. These stories aren't new. These and similar scams have been circulating for a long time with victims losing traditional currencies or gift cards. The difference is scammers are now using cryptocurrency to facilitate the scam. Cryptocurrency on its own isn't a scam, people invest money in cryptocurrency for the same reason they invest in anything, hoping it will rise in value.

Cryptocurrency 101

Cryptocurrency is a digital currency, meaning it exists only electronically. It is decentralized in that no bank or other government authority backs or controls the currency. It is a direct transaction sent and received electronically between peers. Transactions are recorded on a blockchain, which is a digital public ledger of all transactions. The ledger is distributed, meaning it doesn't exist on just one computer; anyone can download a copy of it onto his or her computer. The transactions on the blockchain are secured by encryption using cryptography**.** The word 'cryptocurrency' is a combination of cryptography and currency. Cryptography uses complex mathematical algorithms, requiring massive amounts of computational power, to provide security for cryptocurrency transactions. 'Miners' generate new coins and confirm cryptocurrency transactions by solving those cryptographic algorithms.

Bitcoin was the first cryptocurrency, debuting in 2009, and remains the most popular. There are now more than 9,000 different cryptocurrencies,[ii] including Ethereum, Litecoin, Dogecoin and Monero. The top 20 cryptocurrencies make up approximately 90 percent of the total market. Bitcoin's market cap is approaching $1 trillion, which is greater than the other 19 cryptocurrencies combined.[iii]

Purchasing Cryptocurrency

Cryptocurrency can be purchased using an app on your cellphone, on a website on your computer or by using a cryptocurrency ATM. Transactions are linked to individuals by their wallet address, which is a long string of numbers and letters.

Hardware Wallets

The Trezor Hardware Wallet is "a super secure, physical piggy bank for your cryptocurrencies," according to the website (trezor.io). As a digital vault, the wallet enables online and offline transactions. If the wallet is lost, its data can be recovered by contacting Trezor.

Cryptocurrency exchanges help match buyers and sellers, or exchange one type of cryptocurrency for another. Available exchanges include Coinbase, Gemini, Crypto.com, BitMart and Binance. Exchanges can also be accessed via cellphone or computer and support a variety of payment methods, including cash, bank transfer, debit card, credit card and PayPal.

Cryptocurrency ATM machines—also known as Bitcoin ATMs or BTMs—can be found in many locations. In 2023, there were more than 63,000 BTMs in the U.S., some of which enable Bitcoin purchases only, and others also allow selling Bitcoin.[iv] Transactions in other cryptocurrencies must be made on an online exchange.

Purchasing from a BTM requires a wallet address. Methods of purchase include cash—which guarantees anonymity—and, depending on the BTM, credit cards and payment apps. As a result, these BTMs are the focus of scammers.

Another two considerations to note when using a crypto BTM are fees and purchase price. Transaction fees range from 3 to 20 percent, which could amount to $2,000 for a $10,000 purchase simply for using the machine. As well, be aware that many BTMs inflate the purchase price for Bitcoin from $48,040.70 on February 11, 2024, for example to $53,805.58, a 12 percent hidden fee.

Wallets

Transactions don't have names connected to them but rather transaction identifiers, connecting a sending wallet and receiving wallet, as well as the transaction amount and timestamp. A cryptocurrency wallet is where a user's public and private keys are stored. Unlike a traditional wallet that stores cash, a crypto wallet doesn't store the actual currency but rather the keys to that currency. The public key is open to anyone in the system to see and allows users to receive transactions. The private key is matched with the public key and proves ownership of the wallet. The private key should be stored separately from the public key and kept secret.[v]

There are different types of wallets, hot and cold, the key differences being whether they are connected to the internet.

A hot wallet generally takes the form of an app or software installed on a computer that stores your private keys. There are web-based, desktop-based and mobile hot wallets, all of which are connected to the internet. Hot wallets are faster and more convenient to access than cold wallets and generally operate without cost. Storing large amounts of cryptocurrency in a hot wallet, however, is not recommended since they are vulnerable to attack.

Cold wallets are stored offline and are generally more secure than hot wallets. They can be hardware based, on paper or in a separate offline computer. Hardware wallets often resemble a small USB stick. Unlike a hot wallet, hardware wallets can cost anywhere from $50 to $200, a small price to pay for security if you own large amounts of cryptocurrency. Cold wallets take longer to access, so they are not ideal for making frequent trades. Paper wallets are a type of cold wallet in which you print out your public/private key pair. Sending money to a paper wallet requires the public key, while receiving money from a paper wallet requires the private key. The risk of having a paper wallet is losing or destroying the paper. Once lost, there is no possible way to recover any funds.

Anonymous?

Some types of cryptocurrency claim to be anonymous. However, Bitcoin is not anonymous in that the transaction ledger is public, so anyone can download a copy. There are many websites available, both free and fee-based, that assist in tracing transactions, albeit some are easier to use than others.

Since the ledger is public, making the transactions traceable, how are these scams so prevalent and hard to track down?

Scammers obscure the money trail by using virtual services called 'mixers'—also known as tumblers, shufflers or blenders—that 'mix' the targeted user's cryptocurrency with crypto assets from multiple addresses for a period of time before sending the assets at random periods to their destination addresses.

A 'shapeshifter' is a type of mixer that takes this process one step further by converting the funds into a different cryptocurrency for added anonymity.

Even if a mixer of some sort isn't used in the scam, other obfuscation techniques might be employed, such as connecting to the internet using a virtual private network (VPN), which enables the perpetrator to hide the originating IP address.

Also, there are unfriendly and/or unregulated cryptocurrency exchanges, which might be offshore, that may not cooperate with law enforcement in providing customer information. If the funds end up in an exchange controlled by a foreign country that will not cooperate with U.S. law enforcement, little can be done.

Cryptocurrency Recovery Companies

Many companies claim to recover lost cryptocurrency for a fee. These companies may be able trace the cryptocurrency using the methods described above. While they may be able to see where lost cryptocurrency may have gone, *no private company can recover funds*, only a law enforcement agency may be able to recover lost funds. Contacting law enforcement should be your first step. Recovery companies charge fees to trace funds, law enforcement does not. If a recovery company charges an upfront fee with promises of recovery, they are not legitimate. Their fee schedule should be clearly stated along with their capabilities.

Some recovery companies can be of assistance to law enforcement agencies that are not knowledgeable about cryptocurrency or don't have the funds for the costly tracing tools, but using their services comes with significant cost.

Cryptocurrency Scam Protection

The first rule to protect against scams is an old one: If it sounds too good to be true, it probably is.

If you are going to invest in cryptocurrency, only invest what you are willing to lose since

Anonymous?

Scammers are able to achieve anonymity because of the difficulty in tracing their illicit money trail, which they obscure with virtual services including 'mixers' that mix the target's cryptocurrency with multiple addresses before sending the assets to their destinations. An advanced mixer, called a 'shapeshifter,' converts stolen funds into different currencies for added anonymity.

cryptocurrency's value is highly volatile. Unlike traditional investing in stocks and bonds, there are no businesses nor physical assets backing cryptocurrency with earnings or products. The value of cryptocurrency is built on supply and demand.

Investing in cryptocurrency is not inherently bad, but be sure to know what you are getting yourself into. To understand Bitcoin more thoroughly, please refer to Prof. Marcus Fries's article, "CBDC vs Bitcoin: Privacy & Freedom or Total Control?" beginning on page 13. There is also a comprehensive whitepaper, "Bitcoin: A Peer-to-Peer Electronic Cash System" by Satoshi Nakamoto, Bitcoin's alleged creator.[vi]

What not to do may seem obvious after reading these stories, but these scams are prevalent. The traditional romance scams are turning into investment scams where instead of flat out asking for money, scammers are encouraging their victims to invest. Another term for this is "pig butchering." The scammers initiate contact and build a relationship with the victim before getting them to invest a small amount of money through a fake site. They often let victims withdraw a portion of the money to build trust before encouraging them to invest more and more. The term "pig butchering" comes from the fattening process, the manipulation to invest more and more, before cutting them off completely.

What to Watch For

Fake Investment Scams

Unsolicited Offers: Avoid unsolicited offers of investment assistance. The so-called expert or very attractive person messaging you on social media is likely a scammer. They make you feel special for choosing you or pretending to give you information no one else has. Beware of someone you have never met in person giving you investment advice. If it was such a great deal, everyone would know about it.

Unrealistically High Returns: No one can predict future returns on an investment. Guaranteed returns on any investment are a giant red flag. Scammers lure their victims with "per day" returns given as percentages that could

sound realistic, such as 2 or 3 percent per day. However, 3 percent per day equals 1,095 percent per year, which is a highly unlikely return on any investment.

Paying a Tax: Taxes are paid to the IRS, not to withdraw money. If anyone asks you to pay a tax to withdraw funds, know that it is a scam.

Investment Sites: Only use trusted sites, never use a link that someone sends you. Research trusted exchanges and use their apps or websites.

Popup Ads

Don't call any number that appears in a popup. These are often accompanied by a loud sound telling you that your device has been hacked or that its protection is out of date. These ads attempt to impersonate Microsoft, Google or other tech companies to get you to call their phone number. Take a picture or screenshot of the popup window and then close it and shut down your computer if necessary. If you are concerned there is a virus on your computer, take it to a computer repair shop to be scanned.

No legitimate business is going to demand you send cryptocurrency in advance – not to buy something, and not to protect your money. That's always a scam.

Warrants

Government agencies won't call, text or email you without warning to demand payment immediately. They will *never* ask for payment in gift cards or cryptocurrency. Caller ID can be manipulated, so don't trust that the caller ID you see on your phone is legitimate. Look up the phone number on the agency's website or another trusted online source or better yet, go to the local sheriff's office. Do *not* share personal information with someone who contacts you unsolicited.[vii]

Other Variations

Grandparent Scam: A person gets a call from someone claiming that their loved one is in trouble. They have been hurt, arrested or otherwise need help. The scammer will often fake the loved one's voice or claim that he or she can't talk. The scammer creates a sense of urgency to try to get the person to act quickly.

Lottery Scam: A scammer calls, texts or emails that you have won the lottery. You just have to pay a fee to claim your prize.

Where to Find Help

A list of other cryptocurrency scams can be found here at the State of California's Department of Financial Protection & Innovation.[viii] If you or someone you know falls victim to one of these scams, report it to your local law enforcement agency. Additionally, to help other people from becoming victims, scams can also be reported to government agencies, including the Federal Trade Commission, FBI's Internet Crime Complaint Center and the U.S. Securities and Exchange Commission.

There are also handouts available online articulating details about what to look for and how to avoid some of the common scams, such as Online Dating Scam,[ix] Grandkid Scams[x] and Lottery Scams.[xi]

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[i] https://public.tableau.com/app/profile/federal.trade.commission/viz/FraudReports/PaymentContactMethods
[ii] https://www.statista.com/statistics/863917/number-crypto-coins-tokens/
[iii] https://www.bankrate.com/investing/types-of-cryptocurrency/
[iv] https://www.bankrate.com/banking/what-are-bitcoin-atms/
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[xi] https://madlabs.dsu.edu/digforce/docs/Lottery_Scams.pdf

Innovative Approaches to Destroying **Herbicide-Resistant Weeds**

WILLIAM ADERHOLDT, PHD
Director of Grand Farm

For the past 70 years, herbicides have been used to control weeds in agriculture.[i] This is a major factor enabling farming to greatly increase food production worldwide, which led to more than a tripling of global population from 2.5 billion in 1950 to 8 billion in 2023. Unfortunately, widespread herbicide use has the unintended effect of creating herbicide resistance in multiple weed species, which is one of agriculture's top challenges.

Xin (Rex) Sun, PhD, Associate Professor, Department of Agricultural and Biosystems Engineering, NDSU, conducts a demonstration with an advanced agricultural spray drone, which is designed to optimize efficiency and precision. This drone can spray 15 acres per hour, and the remote-control system enables control of five MG-1Ps within a three-kilometer range, enabling coordinated, synchronized operations. The drone features a Real-Time Kinematic system that ensures precision in navigation and positioning, enabling accurate and consistent flight paths.

When removing 99.9 percent of weeds in a field, there is the 0.1 percent that live, produce seeds and then multiply. This has effectively created a very costly arms race with chemical companies working on new formulations of herbicide and seed companies working to keep up with trait development. Growers in turn are reliant on the technology these companies are creating to be able to keep up with their production.

In agriculture, there is a pressing concern, especially in specialty crops and non-genetically modified crops (non-GMOs), that solutions won't be able to keep pace with the resistance of weeds. For genetically modified crops (GMOs), seed companies are stacking traits with glyphosate resistance (combining multiple approaches that have proven successful in the past) to stay ahead of herbicide resistance. However, seed companies continue to see negative economic impacts due to herbicide resistance.[ii] This has led to the creation of multiple innovative solutions to address these weeds, including the use of robots and drones, integrated heavy equipment and genetic targeting.

As we look to the future, there are several alternatives to herbicides heading into commercialization—strongly signaling a solution to herbicide resistance in the near future. These solutions include robots and drones, integrated heavy equipment and the genetic targeting of weeds. The approaches being discussed decrease the need for traditional herbicides[iii]—with some researchers estimating a 90 percent reduction in herbicide usage.[iv] However, many researchers in the agriculture technology industry believe that multiple different solutions will need to be adopted to fully address herbicide resistant weeds.

The following sections discuss these solutions and challenges to their commercialization.

Robots & Drones

Robots and drones are some of the most talked-about solutions in agriculture to address weeds—these include both ground and air applications to destroy herbicide resistant weeds. Similar to integrated heavy equipment techniques, robots and drones rely on two modes of action. First, they must be able to identify the weeds; and second, they must be able to perform an action on the weeds. This creates a challenge to consistently identify and destroy weeds.[v] Weed identification with both the ground and air technology remain a core challenges.

Palmer amaranth can be a farmer's worst enemy. It can grow 2 to 3 inches per day in optimum conditions and reach a height of 6 to 8 feet. A single plant can produce up to 1 million seeds. Especially heavy infestations have reduced yield up to 79 percent in soybeans and 91 percent in corn. Palmer amaranth is extremely hard to control because it is prone to being resistant to several herbicides.

To develop this technology, extensive imagery needs to be collected, and the training of detection algorithms is time consuming and costly.[vi] Advancements in hyperspectral sensors (providing access to a wider spectrum of light) have allowed for more consistent and accurate classification of weeds versus crops.[vii]

This solution does not rely on the use of specialized seed traits for crops. Researchers and industry have made both significant advancements in the development of detection algorithms and platforms to destroy weeds once identified—combining both into often smaller platforms (about the size of a folding picnic table) that can use specialized chemicals, lasers, heat or mechanical means to destroy the weeds. Since the platforms are smaller than the heavy equipment used in production agriculture, swarms of these devices will be needed when used on larger amounts of acreage.

Integrated Heavy Equipment

Integrated heavy equipment removes the challenge of creating a platform that can navigate farm fields and instead focuses on the detection of weed species crops.[viii] These solutions have a similar challenge to that of robots and drones since the development of algorithms is time consuming and costly. Integrated heavy equipment has seen the most commercial advancement, most notably from products such as John Deere's See & Spray™. These products integrate right into the already established workflow of producers, minimizing impacts on established timings of applications. Solutions in heavy equipment integration have been known primarily to use specialized chemicals and/or lasers to destroy weeds.

Genetic Targeting

Genetic targeting of weeds as a method to destroy them has piqued a lot of interest in the agriculture industry; however, it remains widely untapped.[ix] This method, called RNA interference (RNAi), impacts the RNA function within the weed by targeting and engineering for specific genetic sequences. Spray-induced gene splicing (using sprayers to deploy various types of RNAi) has been used to reverse herbicide resistance, allowing for the use of traditional herbicides again.[x] One of the challenges of this method is that a specific RNAi formulation is needed for individual weed species. Similar to integrated heavy equipment, genetic-targeting products would keep farm operations looking relatively the same with timed applications using sprayers throughout the season.

Positive Next Decade

Effective solutions to herbicide resistance are emerging rapidly. Researchers and organizations are working assiduously on solutions to address this challenge by using robots and drones, integrated heavy equipment and genetic targeting to tackle these weeds head-on. Each of these solutions will encounter challenges when applied to different geographies, cropping systems and growers' workflows. While multiple unique challenges to each solution have been introduced throughout this article, these are in no way insurmountable.

Over the past five years, several of these solutions have reached pre-commercialization (and some are in commercialization)—being tested in small, medium and large-scale operations throughout the world. In addition to viability in the destruction of weeds, return-on-investment will also need to be studied to determine if these solutions are suitable for individual farm operations. The future is quite positive, as the next decade will see substantial advancement in diverse technologies to address herbicide resistance. ▣

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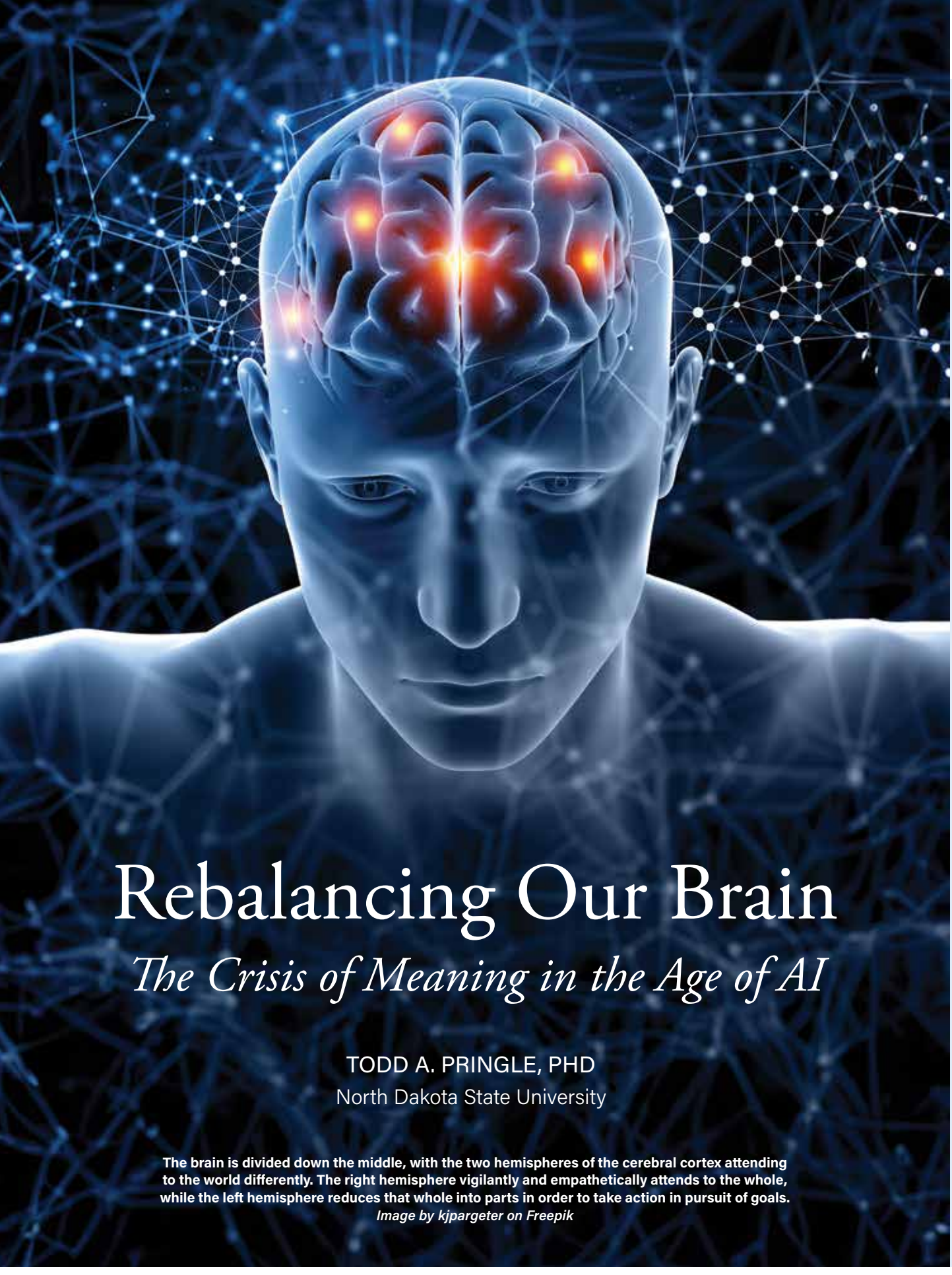

Rebalancing Our Brain

The Crisis of Meaning in the Age of AI

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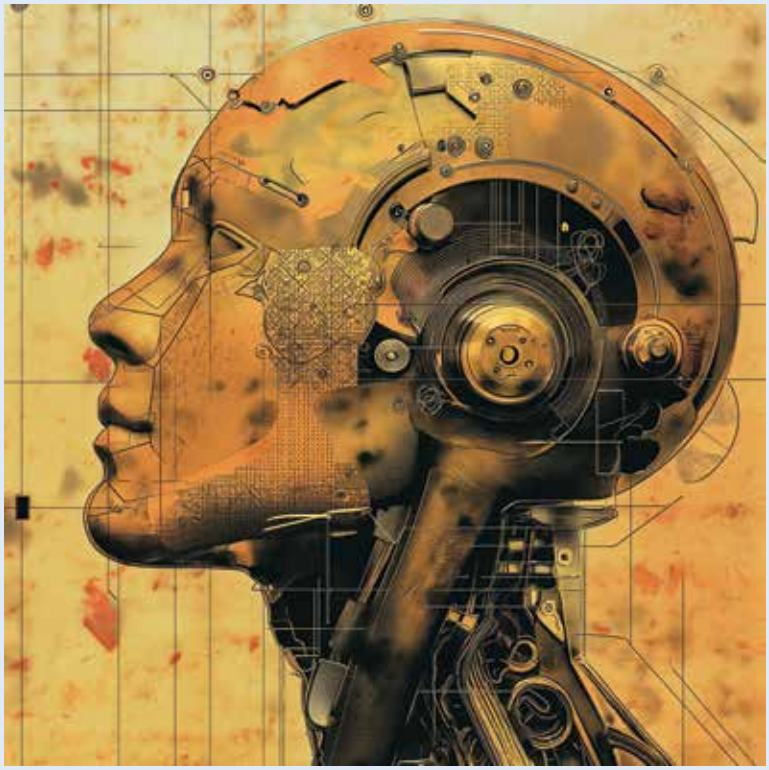
The brain is divided down the middle, with the two hemispheres of the cerebral cortex attending to the world differently. The right hemisphere vigilantly and empathetically attends to the whole, while the left hemisphere reduces that whole into parts in order to take action in pursuit of goals.
Image by kjpargeter on Freepik

Does the deepening crisis of meaning and the rise of nihilism, despair and hedonism in modern society stem from an imbalance between our brain's hemispheres? In his seminal work, *The Master and His Emissary: The Divided Brain and the Making of the Western World*, Dr. Iain McGilchrist delves into how the left and right brain hemispheres have shaped the trajectory of Western Civilization. He argues that our cultural constructs have bolstered the left hemisphere's dominance, creating a feedback loop that inhibits the right hemisphere, leading to profound consequences for humanity.

In a recent conversation with McGilchrist, Michael D. Robinson, Professor of Psychology at NDSU, and I discussed how the advent of artificial intelligence's (AI) large language models might dramatically increase this imbalance, potentially exacerbating many contemporary problems. Reflecting on our discussion, it seems we are at a foggy crossroads especially in the West, with AI emerging at a time of cultural tumult and the fraying of our binding social narratives.

To determine how to use AI to make life better, not worse, we must first understand how we got here.

We are at a foggy crossroads …with AI emerging at a time of cultural tumult and the fraying of our binding narratives.



According to Dr. McGilchrist, a mechanistic worldview resulted from several centuries of a feedback loop in which the world we constructed cohered with the reduced, mechanistic perspective of the left hemisphere, neglecting the implicit, relational perspective of the right hemisphere. ***Midjourney 6.0 Bot Prompt: Rebalancing our Brains: The Crisis of Meaning in the Age of AI.***

Brain Hemispheres & Language

Late 20th-century pop psychology oversimplified the "left brain" and "right brain" into dichotomies such as creative/emotional versus logical. McGilchrist debunks these tropes, offering a more nuanced and interconnected understanding. The left and right hemispheres of the brain, each with overlapping and distinct functions, evolved for coordinated action. The left hemisphere simplifies the complex world into actionable elements, including tools, obstacles and goals, while the right hemisphere processes the broader context, alert for opportunities and threats.

This division of cognitive labor is not unique to humans; many animals, including birds, exhibit similar hemispheric functions. Some describe the evolved hemisphere's roles as enabling animals to simultaneously be a predator while avoiding becoming prey. The left hemisphere takes action in the world, confident and narrowly focused like a predator, while the right hemisphere attends to wider world, vigilant for the unexpected.

The dynamic narrative of language can be viewed as a form of abstracted action, primarily (but not exclusively) processed in the left hemisphere. Language reduces complex thoughts into a series of spoken words or written symbols, compressing experiences and their abstracted concepts into communicable packets. However, this compression often leads to diminution of depth and nuance, necessitating the use of tone, body language and metaphor for richer communication. Understanding language as a form of compression reveals its limitations in conveying full meaning.

In language processing, the left hemisphere predominantly manages the compression, or dimensional reduction, of thoughts into words (and vice versa). However, the right hemisphere plays an indispensable role in fully extracting meaning from language. It is often the implicit processing of tone, body language and metaphor by the right hemisphere, experienced in conjunction with the explicit words processed by the left hemisphere that allow us to derive the richest meaning from our communications.

The development and evolution of language enabled humans to store and share experiences, which enabled us to construct ever more sophisticated cultural elements. We live in an increasingly constructed world, both literally (concrete, straight lines, roads) and conceptually (rules, norms, philosophies). A storm sometimes reminds us that there still is an unconstructed natural world. But most of us only experience "nature" when it's domesticated via pest and predator removal, and full of affordances such as walk paths and rest areas.

Historic Shifts Towards the Mechanistic

McGilchrist views Western Civilization's advancement as a journey towards a more controlled, artificial and predictable world as language developed progressively more intricately explicit concepts. Our left hemisphere sees the world as mechanistic parts for action, and our technological advancements are power projections and reinforcement of the left hemisphere's mechanistic view. McGilchrist argues that the historic

In an online discussion including Iain McGilchrist, John Vervaeke, an Associate Professor of Psychology at the University of Toronto, described the pervasiveness of zombies in contemporary popular culture as an expression of the growing crisis of meaninglessness in the West. "They've lost intelligibility, they can't speak, they move in collectivities but form no communities," said Vervaeke. "They drift aimlessly [but] unlike other monsters they don't have any supernatural connection, they're just us ... perpetually decayed." He cited obvious symptoms, such as the growing mental health crisis, and cited an Irish poll in which 83 percent of all respondents and 87 percent of young people (16-29 years old) reported their lives as meaningless. Image from "The Walking Dead: Daryl Dixon" (2023), a post-apocalyptic horror TV series, which is the first season of a spinoff of the original "The Walking Dead" franchise.

shifts of the Reformation, the Enlightenment, and the Scientific, Industrial and Information Revolutions mark increasing entrenchments of left-hemisphere dominance. The loss of the sacred, the ascension of rationality and the prevailing modern notion that existence is limited to what can be explained are seen as manifestations of a worldview sculpted by the left hemisphere.

The hyper-rational, mechanistic modern perspective has brought us unprecedented advancements in productivity, as we have harnessed the powers of physics and chemistry to engineer and construct our artificial world, moving beyond mere interaction with the natural world. The last half-millennia can be viewed as an accelerating feedback loop of technological progress and accompanying linguistic constructions to explain ourselves and our world. We invented the compass, the cotton gin, computers and interchangeable parts for assembly lines partly because we also invented explicit organizational rules, logic, reason, math and complicated philosophical constructions. These were all articulated through explicit words, concepts and taxonomies, defining who we are and how we understand the world. The modern Western world, in this sense, is a manifestation of the reductive and mechanistic perspective of the left hemisphere.

In today's left-hemisphere dominant Western society, and increasingly across the developed world, the belief in phenomena that cannot be mechanistically explained is often dismissed as irrational, superstitious or unscientific. The logical, rational, scientific and mechanistic explanations are generally accepted as the

only defensible positions for almost everything, with notable exceptions for personal preferences such as food, mates or music.

Loss of Meaning & Common Sense

McGilchrist posits that this left-hemisphere dominance is a primary driver behind the current meta-crisis of meaning plaguing the modern world. The focus on the explicit, driven by the left hemisphere's need for explication, has led to a deconstruction of everything into mechanistic parts. Phenomena that once inspired wonder and awe are carved at the joints, critiqued and explained away. Ideologies with simple structures and dichotomies, rational and explicit, infect our minds. We tore down our religious narratives because they lacked the explicit coherence the left hemisphere craves. We lost respect for complex implicit systems and arrogantly and ignorantly construed "scientific" explanations (e.g., genetic determinism) and metanarratives (e.g., Freudianism) to explain human behavior, to sometimes terrible unintended consequences.

Human economic systems are extraordinarily complex, second-order systems consisting of countless entangled factors. Second-order properties emerge from humans, the agents within the system, who act based on their predictions about the system. Simplifying, as Marx did, this intricate system into the binary construct of capital and labor, framed as a power struggle, is a gross caricature.

This strawman argument is used to promote communist ideology as an equally oversimplified solution to the "problem" of capitalism. Marxism was presented as an inevitable logical and scientific progression that sold millions on a utopian dream—a left-hemispheric fantasy in which everything has a neat explanation, and everyone has a defined role. Similar left hemispheric fever dreams of a totalizing explanatory (explicit) framework compete for minds on social media today. Into the void, where our religious frameworks once nested, we fall prey to ideological capture and concomitant loss of common sense.

Risking oversimplifying McGilchrist's thesis, the right hemisphere's implicit wisdom can be seen as our source of common sense. Our pet dogs often know when we are going to leave or take them for a walk, even before we've done anything obvious to alert them, because their right hemispheres are cueing into subtle patterns in our behaviors. Dogs have an implicit sense for things that they use to determine explicit action. In a sense, dogs can "know" things in a way that we can commonly "know" things. Dogs have a kind of canine common sense. When the implicit and the explicit have coherence (when they agree, so to speak), we experience predictability and cognitive ease, and we feel we "know" something. One of the biggest dangers of a left-hemispheric dominant perspective, reducing the implicit perspective of the right hemisphere, is a loss of common sense.

In a culture that achieves hemispheric balance, such as during the Renaissance period, the left hemisphere's need for explicit coherence is counterbalanced by the right hemisphere's gestalt, an implicit understanding of the complex nature of things. Prior to our scientific understanding of phenomena, such as weather and disease, ancient frameworks for interpreting and predicting outcomes in agriculture and health were grounded in alchemical and spiritual beliefs. One had to accept that even meticulously following sacrificial rituals might not always appease the gods. Life was somewhat predictable, but many of nature's subtleties were beyond our explicit comprehension. The left hemisphere's simplistic model of the world was often insufficient, thereby preventing it from arrogantly claiming complete understanding. Conversely, the right hemisphere's intuitive perspective was often adequate and, at times, uncannily accurate, as in "knowing" that it is going to rain or making an intuitive discovery. Over many millennia, a distillation of the collective intelligence of billions of humans produced complex narratives and rituals that blended the explicit and the implicit. These lasting cultural constructs were built upon what proved to be useful and predictable.

As humans gradually discovered new technologies and methods, and as we amassed enough written records to begin discerning explicit patterns, we developed competing frameworks to explain phenomena such as crop yields and health outcomes. Centuries of astronomical observations, revealing heliocentric and elliptical orbits, famously challenged existing paradigms. The invention of the printing press and the

schismogenesis of the Reformation propelled us into an accelerating feedback loop.

In this loop, frameworks rooted in the explicit and left-hemispheric view appeared increasingly predictable, generative and useful compared to alchemical and spiritual interpretations. Viewed through the lens of the modern left hemisphere, human religious traditions appear as jumbled collections of arbitrary rituals and incoherent mandates. To the left hemisphere, only the explicit holds validity.

Gutenberg Galaxy

As we approach the six-century mark since the Gutenberg press revolutionized the diffusion of ideas,[i] Western Civilization has transformed into a secular, materialistic, reductive, mechanistic and hyper-rational culture. Perhaps more than any other single factor, the widespread dissemination of the written word, facilitated by increasingly affordable paper and printing technology, has been a major driver of left-hemisphere dominance. The commodification of written communication enabled us to tap into the collective intelligence of millions within a much shorter timeframe than what was previously required to distill the existing religious and philosophical frameworks. The written word gradually supplanted oral traditions, leading to a growing imbalance in favor of the explicit left hemisphere. As the burgeoning corpus of written human knowledge expanded, we developed ever more detailed concepts and taxonomies to explain various aspects of the world.

Within the span of a human lifetime, we witnessed the advent of the Gutenberg press (circa 1440 AD) and the subsequent Protestant Reformation (1517 AD). The rapid spread of written knowledge ushered in the Scientific Revolution (1543-1687 AD), which fundamentally altered the course of history. The Age of Enlightenment (1685-1815 AD) and the following Industrial Revolution (1760-1840 AD) redefined the world in increasingly mechanistic terms, leading to new technologies and understandings. The spirit of redefining everything in explicit terms can perhaps even be seen as an additional driving force behind the American and French Revolutions (late

This left-hemisphere dominance is a primary driver behind the current meta-crisis of meaning plaguing the modern world.

1700s), with the stability of the former partly due to the preservation of many English traditions and the bloody instability of the latter resulting from the French abandoning all traditions and cutting off nearly everything—literally and figuratively—at the head.

Perhaps this narrative is an oversimplification, but the new historical perspective McGilchrist provides sees this progression as a feedback loop driving left hemispheric dominance, as we literally created an artificial world that was so controlled and predictable that our culture shifted to a hyperrational perspective, dramatically stifling the wholistic, implicit gestalt perspective of the right hemisphere. We have come to a point of such self-domestication in our constructed world, and our explications fit our experienced reality so well, that we no longer trust the implicit. In many ways, we no longer experience the world that the right hemisphere evolved to access.

An astute reader might note that using the hemispheric dichotomy and positing a mechanistic perspective is a very left-hemisphere perspective. We are trying to use words to bring forth a new explicit perspective that evokes the implicit, while acknowledging the constraints that reality is far more complex than mere words can convey. The genius of McGilchrist's thesis is that it uses mechanistic reasoning to delineate the limits and pitfalls of relying solely on mechanistic reasoning. McGilchrist isn't calling for the jettisoning of rationality from our discourse, nor is he calling for a Luddite revolution to turn back the technological clock. McGilchrist contends that despite our material prosperity and advancements in health and lifestyle, we may have lost something essential in the process.

"[W]e have to be constantly vigilant to undermine language's attempt to undermine our understanding."
Iain McGilchrist, The Master and His Emissary, p.150.
Midjourney 6.0 Bot Prompt: The good, the true and the beautiful, and loss of the sacred.

Loss of the Sacred

As we increasingly rely on the analytical left hemisphere, neglecting the holistic perspective of the right, we risk losing the sense of the sacred in our cultural constructs. This shift erodes the foundational values that underpin our morality, reducing them to arbitrary, changeable concepts, devoid of deeper meaning. In this hyperrational landscape, personal 'truths' proliferate, leading to a fragmentation of identity and a weakening of collective bonds. We keep pulling out the strings of the tapestry that once held us together. Some have even deconstructed science, itself a reduction, to be a product of colonial oppression in a recursive race to the bottom for the simplest, most grievance laden cartoon of a worldview that allows its adherents to shed responsibility, while still being the heroes in their own story.

We are Western Civilization's trust-fund children, often ignorant of and ungrateful for the implicit frameworks that our prosperity is built upon. Too many of us believe in nothing, while chasing anything, in order to feel something.

The right hemisphere knows what is good, true and beautiful. It is the cognitive processor of the awe, wonder, respect and deep sense of meaning found in the sacred. Our modern epidemics of suicide, addiction, despair, nihilism, hedonism, narcissism and psychopathy can be traced to this loss of meaning. Moreover, the dark yoke of existential pointlessness, in which our dopamine prisons of social media confine us daily, can been seen as the unintended weeds we have sown with our harvest of material and technological abundance. The modern substitute for the ancient "logos" is the growing digital corpus of humanity, now mostly explicit hyperrational musings of our self-reduction to talking apes. It is this corpus upon which we are training our generative-AI large language models (LLMs).

AI & the Hemispheres

Generative AI represents a fundamentally new interface between humans and computers. These revolutionary LLMs, trained on humanity's written corpus, allow the models to understand our prompts and give us nearly frictionless access to curated,

bespoken syntheses from that corpus. Everything we want explained will now be available to us, simply by asking. These models, in app form, will inevitably learn algorithmically to get better at giving us what we want. And while we like novelty, we don't like uncertainty regarding how the world "works." We can expect an exponential explosion of seemingly novel content for our amusement, appetites and need for expression. We can also expect highly sophisticated construals on demand, explaining everything away into materialistic, reductionist frames, because that is what most of our training data consists of, and that is the perspective our left hemisphere seeks.

There's much discussion about the apocalyptic risks of AI, ranging from human enslavement to extinction. Yet, a less frequently mentioned, but equally daunting, concern is AI's role in potentially accelerating the ongoing erosion of meaning in our lives. We can anticipate efforts to develop 'spiritual' AIs, tailored to process humanity's more implicit works such as poetry, influential fiction, religious texts and sacred writings. These AIs might offer 'ancient wisdom on demand,' some of which could be beneficial. However, the critical question remains: What will we seek from these digital oracles? Will the access to and synthesis of the vast and varied wisdom in humanity's textual heritage through these AIs lead to new sources of meaning for us? Or will it further dilute the quest for profound understanding in a sea of readily available mechanistic answers?

We experience language processing in an embodied manner, unfolding words to extract their meaning. However, the inner workings of the hidden layers in these advanced AI 'brains' remain a mystery. What exists within the weight parameters of the hidden layers of these huge neural nets? Is there an implicit, digital representation of the world—a digital gestalt—that enables these models to perform so effectively? An intriguing question arises: Will the new human generations, 'AI natives,' use these intelligences to reinforce our tendency towards a reductive, left-hemisphere-dominated perspective? Or, alternatively, will these AIs be able to capture and convey the implicit meanings hidden within our vast textual corpus, possibly becoming a conduit for humanity's re-engagement with the sacred?

In the dualistic framework, which Descartes famously developed, the explicit, predictive aspects of the body 'exist' within the physical, spatial realm, while the more implicit aspects of the mind or soul—difficult to deconstruct and explain—reside in a non-spatial realm. Setting aside the debates over this dualism, this concept helps us gain insight into AI and our brain hemispheres.

The concept of a brain can be seen as a detailed abstraction: a materialistic, reductive cultural construct. In contrast, the mind encompasses not only this abstraction but also integrates subjective experiences, emotions, sensory perceptions and consciousness. The AI models we are developing may not be akin to 'minds' in this sense. Instead, AI models represent an externalized augmentation of our brains, perhaps more likely to function as an extension and computational accelerator of our left hemisphere, rather than our right hemisphere. Or as McGilchrist warned in our interview: AI is the left hemisphere on steroids.

The Good, True & Beautiful

The value of the implicit is in the whole experience, and to break that experience into parts, to reduce it to the explicit, is often useful for acting in the world, but much is lost in that reduction. Powerful AI is upon us, and this advancement is going to accelerate our technological and material abundance, for which we should be grateful and rightly express pride in our creation.

If an AI writes a poem that moves you because it speaks an implicit truth, metaphorically, about the human condition, the proper response is also gratitude. However, think twice before you ask the AI to critique and deconstruct poetry. Deconstruction of the implicit comes with a heavy price, and we lost a lot on our road to material abundance.

Too many of us believe in nothing, while chasing anything, in order to feel something.

We have lost much of our common sense, as well as our respect for the sacred. In our left-hemisphere pursuit of what is useful, factual and rational, we no longer pursue what is good, true and beautiful. These transcendental ideals were recognized for thousands of years as the meaningful aims of human existence. Until the modern era, the aim of education, culture and the arts in the West was to inculcate, develop and express the highest versions of what we consider good, true and beautiful.

In contrast, think of a modern American high school, and you will know in your bones that we have lost this understanding. Now ask yourself if you feel an implicit sense of recognition of these transcendental principles. Do you see how far we have fallen as a culture and what we have lost? That implicit sense is your right hemisphere trying to talk to you without words. We need an active and engaged right hemisphere to know, to understand, the transcendent. We need more balance between our hemispheres, between the explicit and implicit, to reconnect with the roots of Western Civilization and revivify the West.

The failure to seek what is good, true and beautiful, and the loss of the sacred, may lie at the heart of our modern maladies. As we integrate powerful AI models into our civilization, we must understand what we have lost and seek to orient these new tools towards the good, towards discovering both implicit and explicit truth, and towards bringing more beauty into the world. ⧈

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[i] McLuhan, Marshall, *The Gutenberg Galaxy: The Making of the Typographic Man,* University of Toronto Press, 1962.

Abe-no-Nakamaro Writing a Nostalgic Poem While Moon-Viewing (1918) by Tomioka Tessai; Tomioka Tessai, Public domain, via Wikimedia Commons

"The sharp dichotomy in our culture between the ways of being of the two hemispheres, which began in Ancient Greece, does not appear to exist, or, at any rate, to exist in the same way, in Oriental culture: their experience of the world is effectively grounded in that of the right hemisphere. ... *Shizen,* the Japanese word for nature, also links it clearly to the right-hemisphere way of being. ... While *shizen* does, of course, refer to the natural world of grass, trees and forest, it also means the land and the landscape, as well as the 'natural self' considered as a physical, spiritual and moral being, something perhaps akin to *Dasein* [the being that is in the world]: thus, though there is a distinction between man, with his will, and nature, the opposition between man and nature implied in the West is absent in Japanese. ... Everything surrounding human life, including mountains, hills, rivers, plants, trees, animals, fish and insects, has its own spirit *(kami)*, and these spirits communicate with one another as well as with those who live there." *The Master and His Emissary,* p. 452-53.

How Cyber Insurance Prevents Post-Cyberattack Disaster

A Business Guide to Essentials & Compliance

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The cost of cybercrime is escalating globally. By 2025, it's projected to reach a staggering $10.5 trillion annually.[i] This figure is more than just a number; it represents the increasing sophistication of cyberthreats and the escalating stakes for businesses and governments worldwide. Geographically, the cost of cybercrime varies as well. The U.S., for example, has been hit hard, with cybercrime victims losing an estimated $42.9 billion in 2023.[ii]

This trend underscores the urgency for businesses and governments to invest in robust cybersecurity measures and policies. Implementing a robust security strategy is mandatory to prevent cyberthreats. In recent years, cybersecurity's landscape has undergone significant transformations, evidenced by the exponential rise in demand for global threat intelligence. The e-commerce

environment is now unpredictable and complicated, due to geopolitical and economic factors, and is under constant cyberthreats.

The advancement of digital technologies has precipitated a new era of cybersecurity threats, as cybercriminals are now implementing more sophisticated methods that enable them to exploit vulnerabilities and gain unauthorized access to sensitive data and information. Cybercriminals are also exploiting AI by using AI-powered malware, phishing scams and social engineering attacks,[iii] which are growing rapidly worldwide and pose significant risks to businesses, organizations and individuals.

The "Trellix 2024 Threat Predictions" report concluded that insider threats are emerging as growing security concerns. Insider threats come from someone who works for or has access to an organization's data and systems. An insider threat could be an employee, a contractor, a partner or a former member of the organization. The report, based on recent business and industry analysis, showed that "insider threats have increased by 47 percent over the last two years, incurring a total loss of $15.38 million." [iv]

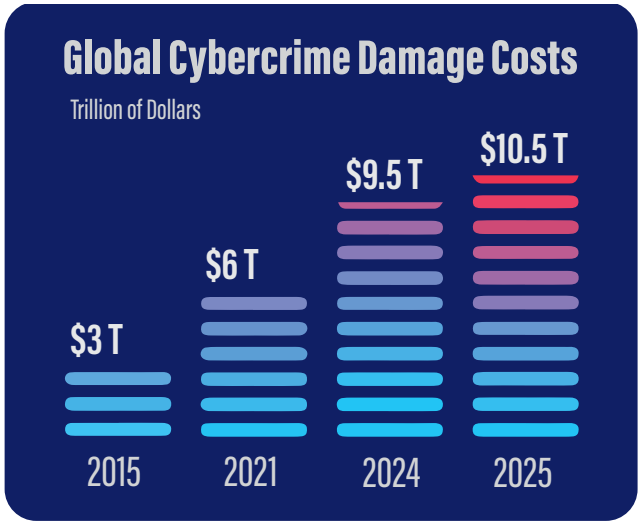
Similarly, another big challenge is advanced persistent threats (APTs), in which an attacker, often a state or state-sponsored group, gains unauthorized access to a network and remains undetected for an extended period. These threats are typically well-resourced and execute sophisticated malicious cyber activity targeted at prolonged network or system intrusion.

Cybersecurity ventures also predict that ransomware remains a major threat to businesses. Ransomware attacks pose severe risks to operations and finances by encrypting files and systems and demanding ransom payments to unlock them.[v] Other significant threats include business email compromise scams, which incurred 1,153 cyber-insurance claims in 2022.[vi]

A cyber incident creates a nightmare for a business. It has a negative financial impact, which goes beyond money to put the company's reputation at risk, often resulting in the loss of customers and investors.

Cyber Insurance: Purpose & Essence

In today's digital world, unseen cyberthreats can overcome even the most robust defenses. In response,



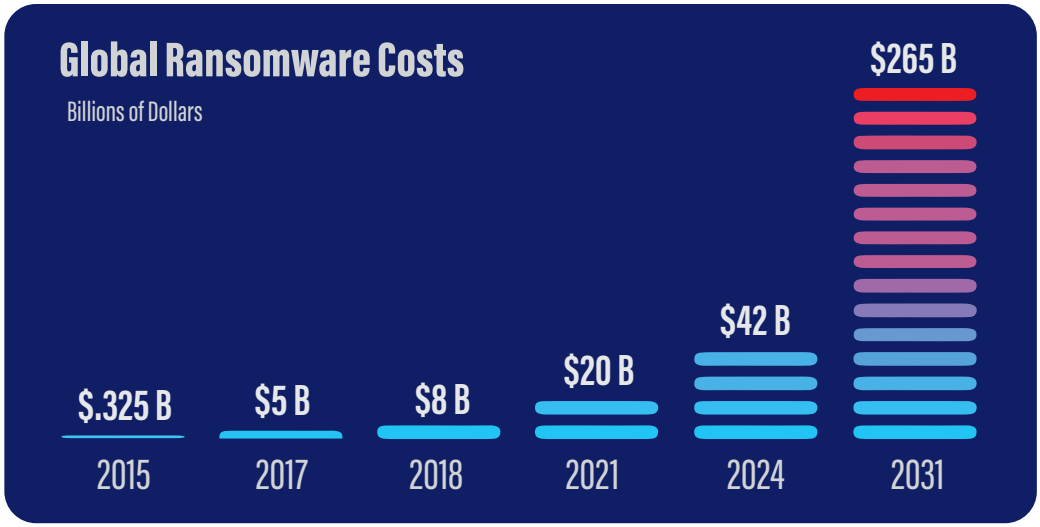
Not only is cybercrime growing by 15 percent per year, "[o]rganized cybercrime entities are joining forces, and their likelihood of detection and prosecution is estimated to be as low as 0.05 percent in the U.S., according to the World Economic Forum's 2020 Global Risk Report." [i]

cyber insurance serves as a virtual shield, providing a safety net to minimize financial damage following an incident. Cyber insurance covers a wide range of expenses—including regulatory fines, legal fees, forensic investigations and data recovery—and costs associated with business interruptions. In the event of a breach, it alleviates the substantial cost of notifying affected customers and provides access to professional response teams, enabling swift and effective incident management. As well, this insurance offsets costs associated with damages and recovery following attacks such as ransomware and data breaches. It also protects businesses from lawsuits, extortion payments and compliance fines.

Cyber insurance also encourages effective cybersecurity procedures and offers experts to help with each stage of the rehabilitation procedure. The digital world is a never-ending game of evolution, adaptation and risk, in which cyber insurance helps competency and resilience.

Based on the most recent projections, the cyber-insurance market is anticipated to grow to $20.6 billion by 2025,[vii] which is more than the market's explosive growth in response to the surge in cyberattacks over the past few years. Cyberattacks increased by 50 percent from 2020 to 2021, far more than businesses or insurers had anticipated.

According to the World Economic Forum's "The Global Cybersecurity Outlook 2023," cyber and business leaders said identity theft, followed by cyber extortion—including ransomware—concerned them most in regard to their personal cybersecurity.[iii]



Tailored Cyber-Insurance Policies

Since all businesses are susceptible to cyber threats, it's crucial to first identify an organization's vulnerabilities. Whether it's a large healthcare organization responsible for safeguarding critical medical records, or a small, rapidly growing company protecting client secrets, each scenario presents its own set of challenges. Cyber insurance coverage must be specifically tailored to address the unique risks prevalent in different industries.

For instance, the manufacturing industry requires policies that address threats such as industrial espionage and disruption of production lines. The finance sector, which handles sensitive data, needs coverage for such threats as data breaches and financial fraud. The healthcare industry, responsible for sensitive medical records, requires policies that cover threats such as patient data breaches and ransomware attacks. Similarly, the education sector, which holds vast amounts of personal and research data, needs coverage for threats including unauthorized access and data theft.

The next question is, what are a company's data jewels? Intellectual property or money transactions, as examples? Accordingly, the cyber-insurance policy must explicitly cover threats against such assets.

But walls alone do not make a fortress. Generic cyber insurance will not work for a sprawling healthcare giant nor an agile startup. Cyber insurance needs precise customized coverage. Startups might concentrate on social media hacking and web shields, while healthcare giants need defense against breaches involving patient-sensitive data especially since they must comply with healthcare standards along with protecting IT infrastructure.

A robust cyber-insurance policy is not just a financial safety net, it's also a wise investment in a firm's digital future. By reducing potential liabilities and helping restore operations, cyber insurance can prevent a cyber event from turning into a catastrophic event that could lead to business closure.

Minimize Risk & Exposure

Utilizing security measures to lessen the impact of cybersecurity threats is known as cybersecurity risk mitigation. Proactive steps include employee training and implementing security controls and robust firewalls, which are usually rewarded with discounts from insurance providers. These measures make a business less desirable as a target for hackers by fostering a security culture within the company.

There are three essential components involved:

1. *Prevention*: The goal of prevention is to avert problems by using strong passwords, firewalls and training.
2. *Detection*: Threats are promptly identified through monitoring systems in the detection process.
3. *Remediation*: Effective response is the focus of remediation.

It is imperative to consistently update, test and modify these strategies due to the constantly evolving cyberthreat landscape. Proactive cybersecurity risk mitigation is quickly becoming the only option for organizations as the likelihood of experiencing a cyberattack is all but guaranteed.

Here are the top strategies for mitigating cybersecurity incidents across IT ecosystem:

A. Evaluate cybersecurity risks, find vulnerabilities and rank fixes in order of importance. For up-to-date information on a company's security, use cybersecurity ratings, which are similar to a credit score and provided by companies such as Bitsight and Security Scorecard. These firms provide evaluations based on data from public and private sources, rendering an objective, easy-to-understand representation of an organization's cybersecurity performance. Security ratings can help organizations monitor, benchmark and improve their security posture, as well as communicate their security performance to external stakeholders. Therefore, by combining ratings with a risk assessment, cyber risks can be proactively identified and addressed in a dynamic and data-driven manner, strengthening defenses against attacks and providing ongoing insights into security performance.

   As well, establish network access controls after conducting an asset assessment to minimize insider threats. To ensure that only the right people can access the right data, what kind of job each person has and what kind of data is needed must be verified. Then use a system that does not trust anyone by default but always verifies identity and permissions. This is called a zero-trust system, and it can help prevent mistakes or misuse by employees, as well as providing a substantial barrier against both internal and external threats.

B. Installing firewalls and antivirus software as primary defenses will improve cybersecurity. While antivirus software looks for possible threats, firewalls serve as a barrier, regulating incoming and outgoing traffic. These tools must be configured correctly and updated often to be effective. Make sure antivirus software can detect new malware and customize firewalls to meet the company's needs.

   Regular audits and updates strengthen overall security, reducing vulnerability to cyberattacks. Proactive action is necessary to lower cybersecurity risks, particularly in light of the estimated 2,200 cyberattacks worldwide every day, through which 800,000 people fall victim to hackers every year.[viii]

   Network traffic must be continuously monitored to provide real-time threat detection and insights into IT ecosystems. This continuous monitoring entails utilizing cutting-edge equipment and knowledgeable staff for in-depth analysis, guaranteeing prompt reactions to anomalous activity and lessening the likelihood of successful attacks. The dynamic approach of continuous monitoring helps organizations stay ahead of threats in the constantly shifting digital landscape by supporting compliance with cybersecurity standards.

C. Finally, employees need cybersecurity training, emphasizing five important points:

   i. Employees should be educated about cybercrime strategies and assisted in identifying phishing emails, links and attachments.

   ii. Employees should be taught how to make strong, unique passwords, along with the value of frequent updates. To increase security, employees need to use multi-factor authentication and avoid using the same password twice.

   iii. Employees should learn how to identify sensitive data and how to handle it safely. This means they should only share, store and transmit data with the people who need it and have the right to access it. This is called the principle of least privilege, which reduces the risk of unauthorized access or misuse of data. Another way to protect data is to assign different roles to users based on their job functions and responsibilities. This is called role-based access control, which allows the system administrator to grant or deny permissions to users based on their roles.

   iv. Employees need to know how to install the latest software, drivers and firmware for their

devices, how to avoid dangerous websites and how to secure mobile devices when using remote access to company resources.

Require staff members to be vigilant when sharing sensitive information and to recognize social engineering tactics. Enforce the reporting of suspicious incidents and foster a cybersecurity-aware culture.

By implementing these proactive defense strategies, a business can opt for cyber-insurance discounts while successfully defending against cyberattacks.

Access Needs & Choose the Right Armor

Selecting the best cybersecurity service provider is the first defense when protecting a business from online threats. The cyber-insurance market is growing rapidly. "According to data shared by global ratings agencies Fitch and Standard & Poor's (S&P), the U.S. market is 80 percent concentrated in the hands of 15 insurance companies."[ix] Choosing a cyber-insurance provider among these or firms with less market share is not a simple task. There are many factors to consider, such as coverage, limits, deductibles, exclusions, premiums and the claims process. There is also a need to evaluate the reputation, financial strength and customer service of the provider.

It is also important to recognize that each provider offers unique policies and coverage options in order to match best with a company's unique needs and vulnerabilities. When assessing a company's operations, identify areas, such as network security or data encryption, that require protection. Evaluate the company's cyber-risk exposure and determine the level of protection needed.

Consider factors such as the type, volume and sensitivity of the data handled; the industry regulations and standards that require compliance; the potential impact of a cyber incident on operations, revenue and reputation; and the existing security measures and controls in place. Invest in customized cybersecurity measures involving cutting-edge technologies or specialized service providers. Before deciding on future needs, conduct comprehensive assessments such as security audits to understand the current cybersecurity posture.

Consult with a cyber-risk advisor or a broker who can help with understanding the cyber-insurance market, analyze the cyber-risk profile, recommend the best cyber-insurance options for the company, negotiate the best terms and conditions with the provider, and assist with the claims process. A risk advisor helps in purchasing cyber insurance, especially if the business is not familiar with insurance language and terms. A risk advisor can also aid in understanding the risks the business faces and recommend the best coverage options for its needs.

Pay attention to the details of the policy, such as what is covered and what is not, how the coverage is triggered, how the limits and sub-limits are applied, how the deductibles and coinsurance are calculated, and how the premiums and discounts are determined. Finally, review the provider's claims process and support services. Find out how easy and fast it is to report a claim; how the provider handles the investigation and settlement of the claim; and what kind of assistance and resources the provider offers in the event of a cyberattack, such as incident response teams, forensic experts, legal counsel, public relations specialists and cyber-risk management tools.

As a comprehensive solution covering costs associated with cyberattacks, cyber insurance is clearly an essential component of any company's cyber-risk management strategy. However, cyber insurance is not a replacement for cybersecurity, as it cannot prevent or stop a cyberattack from occurring. A robust cybersecurity strategy is also required. ▣

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[i] https://cybersecurityventures.com/cybercrime-damage-costs-10-trillion-by-2025/

[ii] https://www.comparitech.com/blog/vpn-privacy/cybercrime-cost/

[iii] https://www.darkreading.com/vulnerabilities-threats/growing-cyber-threats-of-generative-ai-who-is-accountable

[iv] https://www.trellix.com/about/newsroom/stories/research/trellix-2024-threat-predictions/

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[vii] https://www.globaldata.com/media/insurance/cyber-insurance-industry-exceed-20bn-2025-says-globaldata/

[viii] https://us.norton.com/blog/emerging-threats/cybersecurity-statistics

[ix] https://www.nsinsurance.com/analysis/biggest-us-cyber-insurance-companies/


HISTORY'S
DIGITAL
BLACK
HOLE

Challenges to Preserving Records in the iPhone Era

BILL PETERSON, PHD, Director,
and **LINDSAY K. MEIDINGER,**
Head of Collections and Information Management,
State Historical Society of North Dakota

Since the 17th century, newspapers have functioned as important sources of information for historians. Beginning in the mid-19th century, photographs became another crucial primary source. Both newspapers and photographs—in publications and taken by the public—provide valuable insights into past events as they happened, as well as chronicle our ever-changing culture and society.

EXTRA THE BISMARCK TRIBUNE EXTRA

ESTABLISHED 1873 BISMARCK, NORTH DAKOTA, SUNDAY, DECEMBER 28, 1930 PRICE FIVE CENTS

FIRE DESTROYS STATE CAPITOL

Explosion Held Cause of Blaze Which Brings Loss Totaling Millions

Fire today destroyed the state capitol building within a few hours after the blaze was discovered at 7:55 o'clock this morning.

Cause of fire was undetermined as the flames finished the work of licking through the huge frame structure but Joseph Winkel, 65, janitor and night watchman, said he heard an explosion in or near the office of the state engineer and immediately after that heard as of something falling downstairs.

He rushed to investigate, saw the flames and called the fire department. Streams of water were playing on the building within a few minutes but it burned like tinder. With the blaze well under way there never was a chance of halting it with the fire-fighting equipment available.

Although officials would say nothing this morning because they appeared too startled to talk, it is regarded as certain that a searching investigation will be made into the blaze.

LOSS TO RUN INTO MILLIONS

The loss had not been officially estimated this morning but it will run into the millions.

An unofficial list, compiled after brief conversations with officials or employes of various departments, follows:

State Land Department—Records of investments totaling $15,000,000.

GOES UP IN SMOKE

LEADING FINANCIER OF ENGLAND, LORD MELCHETT, IS DEAD

DEMOCRATS FAIL TO INDUCE BROOKHART TO VOTE WITH THEM

Just before 8 p.m. on December 28, 1930, the night watchman discovered a fire in the North Dakota Capitol Building. Flames soon destroyed the structure and would have consumed all the official documents, but for then Superintendent of the State Historical Society, who salvaged items, and Secretary of State Robert Byrne, who retrieved the original copy of the state constitution. "Fire singed his hat, and his fingers were cut by the glass as he made a hurried exit through the window," reported the Bismarck Tribune.

In October 1916, the George Boelter family gathers for a meal in the living quarters of a grain elevator in Arena, ND. The photo captured a historic look at family dynamics, food, a dwelling interior and clothing styles. (Image citation: SHSND 00032-BL-38-00006)

Ironically, and tragically, digitization in recent decades has both greatly increased the number of photographs taken and news sources available online, but at the same time often sequestering them in a virtual black hole. Personal photos are password protected and stored mostly in the Cloud, to which access is restricted. Local print newspapers have declined greatly in number nationwide, especially between the coasts. Online news sources, in contrast, are usually not oriented to specific geographic communities but to increasingly specific interests and polarizing worldviews. Much less attention is given to what happens here and now, especially in rural areas. As well, online news content is stored in the Cloud, and much is behind paywalls. Nor, typically, are the publications' archives available. If 30 photos were taken for a story, for example, only a few are published online and at low resolution.

Photographs as History's Sources

State historical societies nationwide contain massive quantities of photographs. The State Historical Society of North Dakota holds 2.1 million photos, while peer institutions in Montana and Wisconsin contain 500,000 and three million photos, respectively. The same is true for repositories worldwide, including private collections and university libraries and archives. These photographs document everything from the everyday and mundane—daily living, natural landscapes—to the dramatic and newsworthy.

Newspapers as Historical Sources

Newspapers serve as both primary and secondary sources for historians and researchers, as well as journalists and authors. Sometimes called the "first draft of history," newspapers contain stories of local, state and national events as seen by contemporaries and sometimes colored by the attitudes prevalent at the time. No other single source provides as much historical information about communities as local newspapers. Newspapers also document the acts and lives of individuals, making them one of the main sources of information for genealogists as well.

Photography's Darker Room

Many photos in archives and libraries were once part of personal collections. Then as now, people photographed important life events, including birthdays, vacations, graduations and weddings. Prior to the iPhone age, most families stored their pictures in photo albums or kept drawers full of photos. These memory collections were handed from one generation to the next, and families, business and even agencies brought photographs and negatives to various archives.

Archivists, librarians and historians then determined how and if this material fit into the historical record, and whether or not it seemed useful to future

historians and researchers. People invested significant effort, money and time in daguerreotypes, tin types, glass plate negatives, modern slides and prints over the last two centuries, and so attached considerable value to these objects.

Since the introduction of the iPhone and other smartphones, film developing declined almost to zero today. People still take photographs, in fact, more than previously. Currently, 1.81 trillion photos are taken worldwide per year (or 54,000 per second), and this is projected to increase to 2.3 trillion by 2030. These are overwhelmingly digital, and 93 percent are taken on smartphones.[i]

However, relatively few are printed and, instead, often downloaded to a computer, floppy discs, CDs, DVDs and various types of removable hard drives. But these are fragile and mostly password protected. Many digital photos are discarded, or due to increased memory, left on cellphones and then lost when the cellphones are discarded. Or photos are transferred to social media and, again, are password protected. Today's photographs are born digital and remain so.[ii]

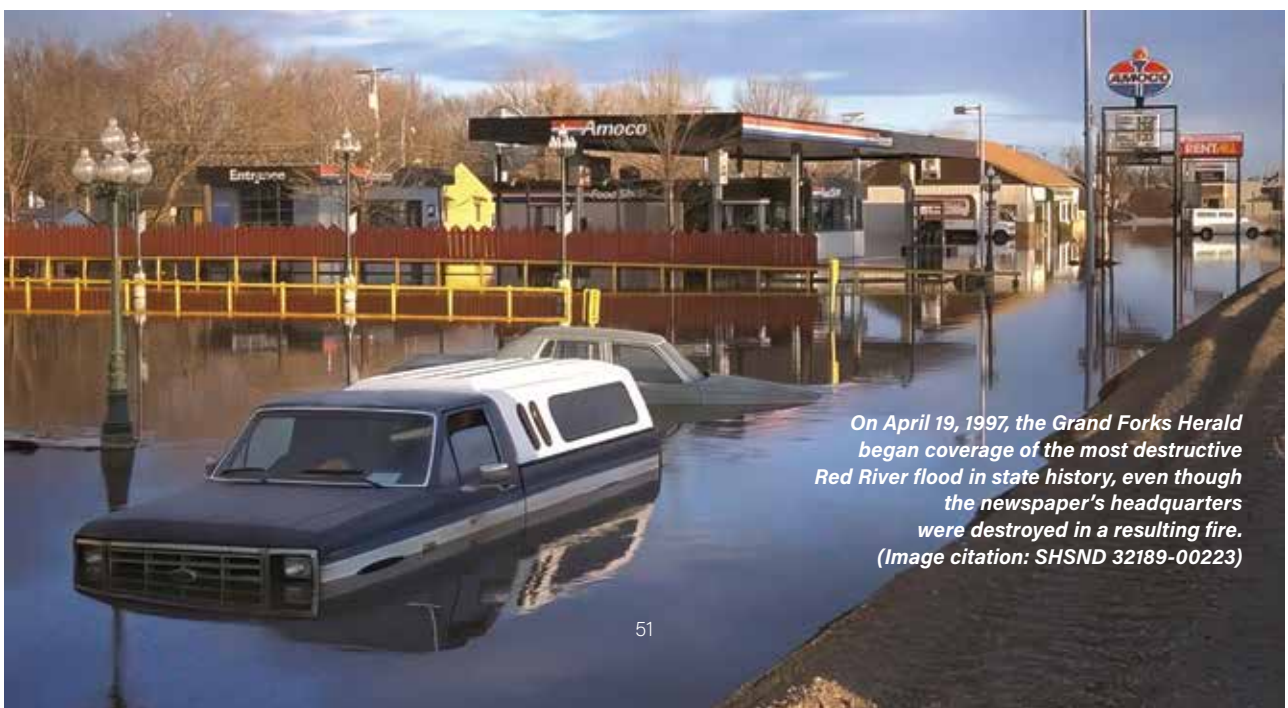
As a result, digital photos are not easily retrieved, as well as less likely to be delivered to local, state or national archives or other repositories. Imagine discovering a trove of digital devices, presumably containing photos, left behind by a deceased relative. If the passwords are unknown, the devices will likely be tossed. Yes, there are companies that can access the stored data, but how often will there be a compelling reason to pay for such services? Or how many children, grandchildren or friends will comb through CDs and DVDs, which are used rarely now? Few people have the hardware to read these items.

Kamal Munir, Professor of Strategy and Policy at the University of Cambridge, sums up the changing nature of photography in his analysis of Kodak's history. Entering the digital age, Kodak, "having played such a central role in creating meaning for photography … failed to believe that meaning had changed, from memories on paper to transient images shared by email or on Facebook."[iii]

Newspapers Unprinting

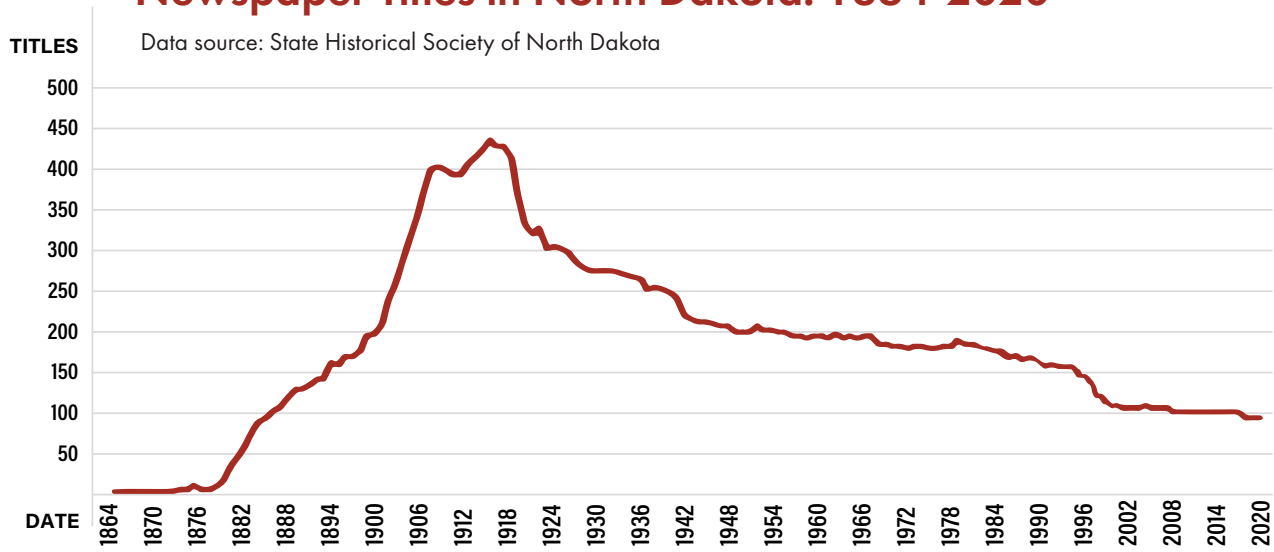
The State Historical Society holds the earliest published newspaper in what would become North Dakota: beginning with Fort Union's Frontier Scout, first published in 1864, and including nearly all newspaper published since then, in print and online. Fortunately, in 1905, the state legislature passed the North Dakota Newspaper Law, requiring all official newspapers statewide to provide copies to the State Historical Society. The law's value was demonstrated during the 1997 Red River Valley flood, when the Grand Forks Herald's newspaper archive was destroyed by fire in the downtown fire.

Some states have similar legislation, but many do not. In Washington State, for example, the state librarian is required to preserve newspapers since they serve as a "valuable historical record for scholarly, personal,



On April 19, 1997, the Grand Forks Herald began coverage of the most destructive Red River flood in state history, even though the newspaper's headquarters were destroyed in a resulting fire. (Image citation: SHSND 32189-00223)

Newspaper Titles in North Dakota: 1864-2020



and commercial reference and circulation." However, publishers are not required to send or transfer newspapers to the state librarian.[iv] Some states, in contrast, such as Kentucky and Georgia, have no laws regarding newspaper preservation.[v] [vi]

When internet use became widespread in the 1990s, newspapers began losing advertising revenue, which pressured many venues to shutter or publish exclusively online. At the peak of newspaper production in North Dakota in 1917, publishers produced nearly 430 newspapers statewide. Today, 74 survive.[vii] According to the North Dakota Newspaper Association, 64 weekly newspapers still print every issue. There remain 10 multiday newspapers, which publish a mix of paper and digital issues. This includes the newspapers from Bismarck, Minot, Devils Lake, Wahpeton, Williston, Valley City, Grand Forks, Fargo, Jamestown and Dickinson.

The total circulation of U.S. daily newspapers peaked in 1984 at 41.1 million and then declined to 24.3 million by 2020, at the same time as the nation's population increased by 42 percent to 336 million.

Samuel G. Freedman, an acclaimed author and journalism professor at the Columbia University Graduate School of Journalism, lamented this nationwide phenomenon in "Losing our Local Newspapers in the Digital Age," published in Dakota Digital Review in January 2021. Not only has there been a precipitous drop in the number of newspapers, but the character of ownership deeply affects journalistic integrity. Previously, newspapers were typically owned by families that "felt it important to keep such papers thoroughly staffed and realistically budgeted as a public service. The new wave of newspaper owners are hedge funds, pension funds and similarly passive investors … demanding profit margins that can only be sustained by rounds of budget cuts, mostly meaning layoffs of staff and reductions in coverage."[viii] Newspapers now often reflect their communities less accurately and so have become less valuable as historical records, even where they survive.

When newspapers were local, communities and state historical societies had better access to photo collections. Access has diminished with both shutterings and purchases by large corporations, one of which, for example, owns more than 100 newspapers, in 43 states, all behind paywalls. Large national and international businesses typically invest less attention and resources in local organizations, including libraries and archives.

Other Sources Dimming

Other primary historical sources are falling into darkness too. TV, print and online news reporters now record images and footage on digital cameras or cellphones. Story text is emailed to editors with no physical copy other than the journalist's initial handwritten notes. And these are becoming rarer as voice transcription and digital notetaking devices improve and become more common.

Before digitization, newspapers stored full editions and clippings, filed alphabetically, along with photos and notes, including many unpublished images and information, in what was termed the "morgue." Few publications still maintain morgues, instead digitizing their records. Custody of some of these collections has been given to public institutions, for example, as listed by the Library of Congress.[ix] But most major publications are missing. The New York Times still maintains its estimated 700,000 pounds of historical paper records alone, which researchers may access for $250 per hour—far beyond the reach of almost all writers, archivists and historians.[x]

As records are digitized and physical copies discarded, not only does access become a challenge but also long-term survivability. Digital storage space, especially for photos and videos, is expensive. How long will media companies pay for this service?

As well, digital content can be hacked and deleted or altered. A comprehensive electric grid failure could jeopardize all digital information. An electromagnetic pulse event (EMP) could disable the entire electrical grid, perhaps for years, denying access to digital records and transactions, and might wipe them out entirely. An EMP could be caused, as examples, by a nuclear attack or another Carrington event, which was an intense geomagnetic storm caused by a solar flare in 1859. Carrington-level events recur about every 150 years.[xi]

Preservation

This time in history is likely the most challenging yet for archivists. In the past 30 years, due to digitization, there's been a decline in content shared with archives and historical societies. Further, the task of preserving digital materials permanently into the future is daunting. Not only is the preservation of images, videos, sound recordings and documents important, but also the preservation of the media on which the content is stored. Swift changes to technology

Members of the 1910 Pembina, ND, baseball team: Roland King, Mike Kelly (manager), Eli Gooselaw, Bart Conmy, Tom Rondeau, Mintie Ormeson, Charlie Ardies, Billie Grumbo, Norman Husband, Forrest Storms, Peter Bouvett and Tommy Schumaker. (Image Citation: SHSND 10737-00089)

produce obsolete file formats, hardware and software, presenting serious difficulties for archivists.

Lack of metadata in digital files causes more emptiness in the historical record. Metadata is crucial to preserving and accessing digital files, since it provides information related to the file's content, structure, preservation and technical aspects. Descriptive metadata also provides details related to the content of the file: the who, what, where and when. This information proves quite useful to researchers. There has likely never another time more documented than today, but what's that documentation worth if it isn't described or accessible in the future?

In terms of what digital preservation looks like to archives, many are still searching for the perfect answer. Archivists now must be adaptable to ever-changing technology. What works for today's digital realm, might not work tomorrow. Implementation of digital repositories and preservation strategies is key to ensure the access of digital history in the future.

Many archives worldwide started keeping older technologies to ensure access to obsolete files and software. These computer museums provide both the hardware and software of the original file format. Other archives focus on emulation or migration as preservation strategies. Format migration is one of the most widely used strategies and involves migrating the file formats to new digital formats. Emulation utilizes current technologies to access original files while mimicking the original technologies that created and used the files.

Best described as a digital stack, in reference to the secure rows of physical storage found in libraries and archives, digital repositories provide long-term preservation, storage and access to digital resources. Key features to digital repositories include ingest steps, data management (preservation) and access methods.

Common steps at ingest include inventory, file format identification, checksum application and virus check. During preservation, files may undergo migration to stable formats and storage. Fixity checks to ensure no changes to the files should occur regularly at all stages of preservation. Technology creates easier and faster access to digital records. In digital repositories, descriptive metadata aids in the access of files. Digital repositories often provide direct access of content to researchers and historians, providing more content to more people. No doubt digital preservation will evolve with technology, and archivists certainly are ready for the task to adapt methods to capture, preserve and ensure access to the historical record, whether digital or paper.

Not only do archivists at the North Dakota State Archives, State Historical Society of North Dakota, curate historical records, they also preserve and maintain outdated computers, operating systems and software applications to ensure that electronic records are accessible in the future. Photo: Jerry Anderson

Archivists—such as Lindsay K. Meidinger (above), Head of Archival Collections & Info. Management at the ND State Archives—digitize old photographs, papers, microfilm, films, videotapes, maps and posters to create public accessibility of historic items. Photo: Jerry Anderson

Microfilm

Although it may seem like an outdated tool, archivists continue to utilize microfilm for preservation and access purposes, especially for materials presented on both paper and digital medias, such as newspapers. A light source is the only required piece of equipment to view microfilm; in contrast, digital files need hardware, software and preservation of bytes. In recent years, the use of microfilm to preserve the content of digital data has increased. Tools that convert digital files to microfilm, such as archive writers, allow archivists to place digital files onto preservation microfilm. The use of imaging technologies, such as overhead scanners and cameras, create the ability to capture the print issues of newspapers and integrate them with the born digital newspaper issues to form a complete run of the newspaper on microfilm in preservation and a digital, text-searchable access copy.

Active Collection

To meet current challenges, archivists are taking a more flexible and proactive approach to collecting materials and spreading awareness. Recent trends show that archivists are increasingly active in early stages of the records lifecycle to assist with developing systems and workflows to fuel long-term digital preservation. For example, archivists in North and South Dakota work with each state's newspaper association to develop standards and procedures for the creation of digital newspapers ensuring easy transfer to state archives for preservation and future access.

Now as historic events unfold, archivists actively collect photographs and witness testimony from private donors to ensuring archival capture. Recently, after noticing a large gap and decline in collection material related to high school sporting events beginning in the 1980s, the North Dakota State Archives put out a call for photographs covering events that cover the past four decades. During the COVID-19 pandemic, many archives worldwide—including Johns Hopkins University Library, Hershey Community

Archivists and librarians at the ND State Archives meticulously catalog and preserve over eight miles of records, more than 2,000,000 photographs, 130,000 publications, and millions of feet of film and videos. Above, Virginia Bjorness, Head of Technical Services, reviews the conditions and locations of books in the secure, climate-controlled stacks. Photo: Jerry Anderson

Archives, University of Nebraska-Lincoln Libraries, Royal British Columbia Museum and State Archives of North Carolina—collected real-time accounts, (including digital stories, images and videos) of people's experiences.

Active collection places the historical record directly into the hands of archivists to preserve for future generations. It also allows archivists to establish how the material is gathered, which helps to create sustainable formats with the proper descriptive metadata. Through actively collecting digital files, archivists can establish what information donors must submit with files for donation. Accompanying descriptive information, such as a caption, date and location, are common requirements for archives to accept digital files to ensure future use of the items. Receiving this information directly from the creator or donor provides an invaluable resource. Most often, the creator of the image can provide more complete descriptions, unlike archivists processing the materials who merely must describe the file to the best of their ability.

Education and outreach help archivists share the importance of active file management and digital preservation strategies, such as multiple copies, format and storage migration, and metadata. These instructions are important not only for business, organizations and government entities, but also individuals to raise awareness of the importance of private collections and family histories to the historical record.

Future Challenges

As archivists and historians improve securing and preserving digital content, they will have to contend with the growing challenge of mining the enormity of digital content and also determining what are authentic versus fake primary sources. While artificial intelligence (AI), with its acuity in pattern recognition, will help with both mining and authentication, AI will also increasingly be used to generate content in accelerating volume and create deep fake documents, photographs and videos that are extremely difficult to distinguish from real content.

Last May, a fake photo of an explosion near the Pentagon, seemingly generated by AI, circulated on social media causing stock markets to drop. This and other deep fakes motivated the major Big Tech companies developing AI, including Amazon, Google, Microsoft and Meta—to pledge they would watermark AI content to identify the work as AI-generated and by which AI service.[xii]

Hopefully, this will soon be implemented. OpenAI, which developed ChatGPT, released an AI detection

tool in January, designed to determine whether content had been created with generative AI. Six months later, OpenAI closed access to the tool since it proved inaccurate.[xiii] However, the need for authentication will ultimately be met, not merely in legislation and regulations, but in reality, or Big Tech with all its astounding applications will lose the public's trust and much of its attention.

Of course, historians, archivists and librarians have found ways to chronicle events for millennia before digitization and AI—and under far more trying circumstances, such as war and persecution, than today. If past is prelude, current challenges will be met, and history's looming digital black hole will ultimately be illuminated. ▣

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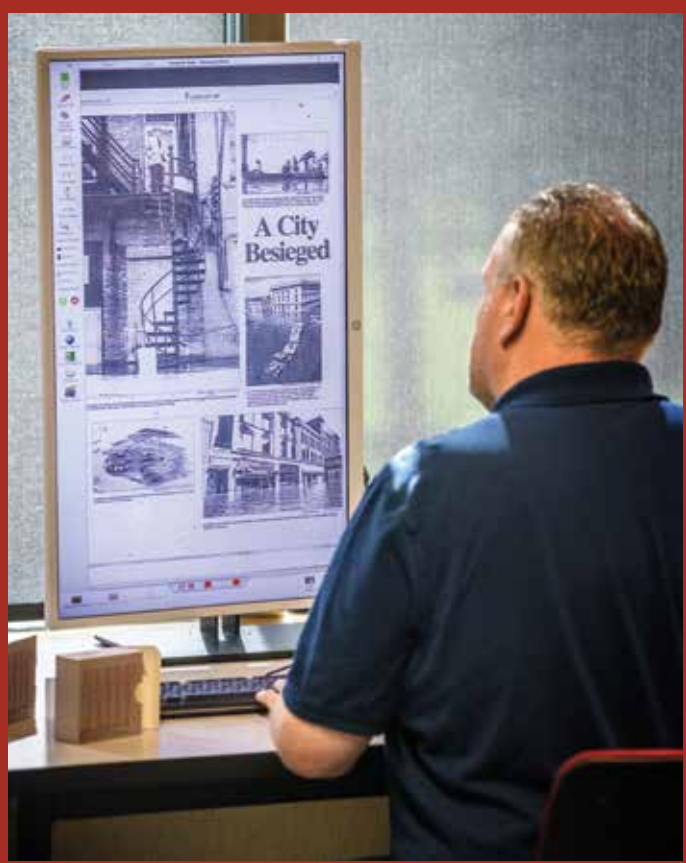
If you don't know history, then you don't know anything. You are a leaf that doesn't know it is part of a tree.

— MICHAEL CRICHTON



In 1905, the state legislature passed the North Dakota Newspaper Law, requiring all official newspapers statewide to provide copies to the State Historical Society. The ND State Archives continues to microfilm all newspapers to ensure the preservation of and accessibility to yesterday's stories.

AI Will Improve, NOT Destroy, Our Jobs

WORKFORCE CHALLENGES IN THE AI ECONOMY

SHAWN RILEY
Cofounder, Bisblox

Since the launch of ChatGPT in November 2022, conversations around artificial intelligence (AI) have exploded. Experts and non-experts alike are making predictions, mostly world ending and societally destructive. Even some of the biggest names in technology are calling for a pause in AI development and clamoring for regulation due to potential doomsday scenarios.

In future articles, I will discuss reasonable doomsday possibilities, but here I dispute the growing fear that AI will take our jobs and force everyone onto a Universal Basic Income. By looking at history and the evolution of the workforce over the past several decades, I'll show that we will continue to have paid, productive careers.

What is AI & Why the Controversy?

AI concepts began in 1936 with the Turing Machine, the first mechanism to simulate human actions. Yes, it was revolutionary, but only a first step. In 1956, the term "artificial intelligence" was coined by John McCarthy, a pioneer behind what is widely considered to be the first functioning AI program, which was very simple and not intelligent. The explosion of science fiction, starting in the 1950s, dreamed of AI possibilities that technology couldn't yet match. An avid television watcher could be forgiven for believing that every computer in the world was evil and dreamed of taking over the world and killing its human oppressors. Many children of the 1980s fully expected that, by 2023, we would see Robocop fighting the Terminator in the streets. Sci-fi in the 1990s portrayed intelligent machines enslaving the entire human race to turn us into batteries.

Hollywood seldom depicts beneficial AI. Mr. Data from "Star Trek the Next Generation" and Kit from "Nightrider" are among the few intelligent machines that don't want to murder us all. It is no wonder that most people are afraid of technology.

While Hollywood made movies such as "WarGames," in which Joshua, an intelligent computer, planned to nuke the entire world simply to win a war game, real-world computers were vastly disappointing in comparison. Unable to interrupt spoken language or even hold enough information to take a decent photo, the real machines of the 1980s and 90s were good only at quickly sorting and organizing data—a long way from intelligence.

From the 1930s through 2000s, hardware systems became hugely more capable, following Moore's Law of doubling processing speed about every two years. However, the software was not comparable to anything we perceive as intelligent. Computers

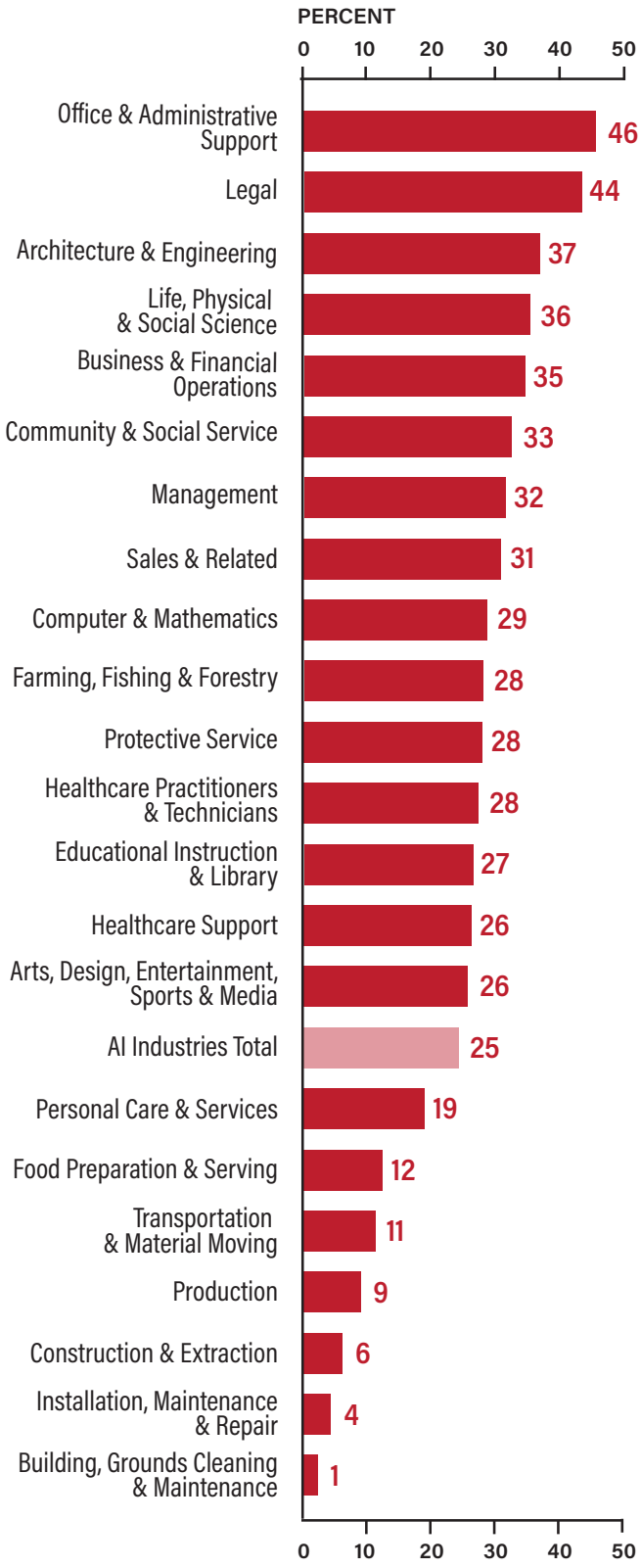
A robotics engineer working on the maintenance of an AI-controlled robotic arm in a factory warehouse.

impressed the world with games such as chess, becoming world champion in 1997 with IBM's Deep Blue. But the machine wasn't doing critical thinking. The software was an optimization engine, meaning it ran all possible outcomes for every move on the board in its memory and selected the most probable outcome. Regarding "intelligence," this was akin to a magician making a rabbit disappear by removing the light shining on the hat. The rabbit *looks* like it disappeared but is still in the hat. Similarly, Deep Blue *looked* like intelligence, but the young AI was just performing fast calculations with the potential for 10^{111} board moves: insurmountable for a human but possible for a computer.

Fourteen years later, in 2011, IBM's Watson won the TV game show "Jeopardy," marking a true leap forward in software's capability to do intelligent tasks that weren't merely crunching numbers faster than humans. While extraordinary, this was still a simulation of, rather than, real intelligence.

AI, by its nature, simulates intelligence, which often tricks people into believing a true intellect is at play. Modern AI can learn from experience, use that learned knowledge to draw conclusions, identify subjects in pictures, solve complex problems, understand different languages and create new concepts. While these appear intelligent from a distance, closer examination shows that the software is meeting a fit-for-purpose design, built to be exceptional at managing data and tasks that are commodity (identical in nearly every situation) and so repeatable, predictable, mundane and boring.

One-Fourth of Current Work Tasks Could Be Automated by AI in the United States and Europe



This sort of work is the essential reason computers exist, and why the world is putting so much effort into developing AI technology. Most people do not fully understand nor appreciate how much of our work in every industry can be described by these five words, making it the perfect candidate to be replaced by AI.

AI & Workforce

Populations in developed countries are in serious decline. Although the American fertility rate has dropped to 1.78—below the demographic replacement rate of 2.1—it is much better than other industrialized nations. Japan, for example, is currently projected to fall to half their current population by 2100, while China will likely have fewer people of working age than the U.S. by 2045.

The workforce consequences are profound. In the U.S., 47 states currently maintain unemployment rates at or below 4 percent, which is considered "full employment." Every state is aggressively recruiting workers in fields such as healthcare, agriculture, high technology and other industries requiring polytechnic skills. The production requirements of our businesses and services nationwide far outstrip our capacity. States such as North Dakota have endured workforce crises since 1970, seldom able to attract needed talent. Today, with an unemployment rate less than 2 percent, almost all organizations are recruiting. AI offers a solution—not to replace workforce but augment it as a tool.

This is where AI transitions from being the "big scary" to being one of the only true hopes for our massive workforce gap issues here and worldwide. Most folks can appreciate tool augmentation in manufacturing. Consumers, whether shopping for cars or pencils, need high levels of consistency and quality, which AI provides by increasing reliable precision in fabrication.

Manufacturing jobs have slowly been replaced by automation since the 1980s. From 1990 to 2000, manufacturing jobs fell from about 19 to 15 million, while counterintuitively salaries increased by 18 percent. Automation eliminated lesser skilled tasks, thereby pushing the remaining productivity to higher labor values.

In healthcare, the U.S. currently has severe personnel shortages in all aspects, including doctors, pharmacists,

anesthesiologists, and we lack several hundred thousand nurses. We aren't teaching enough clinicians for the demand.

While every patient has a unique condition(s), many aspects of care are very similar from plan to plan. Here AI already excels at utility and additive value, for example by personalizing treatment plans and remotely monitoring individual patients, analyzing entire population groups, optimizing medical tests, operating preventative care programs, administering medications and providing robotic care assistants.

One of healthcare's biggest concerns is the application of medications. Errors can cause serious side effects for patients, up to and including death. In fact, medication mistakes impact more than seven million American patients yearly[i] and cause between 7,000 and 9,000 mortalities.[ii] Even a non-emergency medication error costs about $4,700 and increases the patient's hospital stay by 4.6 days.[iii] AI-enabled medication verification systems ensure the patient receives the correct drug (taking allergies into account), dose, time and correct route (the location of medication administration, such as oral or injection). Several such systems have been deployed recently in medical centers nationwide and are expected to achieve a tenfold error reduction compared to manual systems.

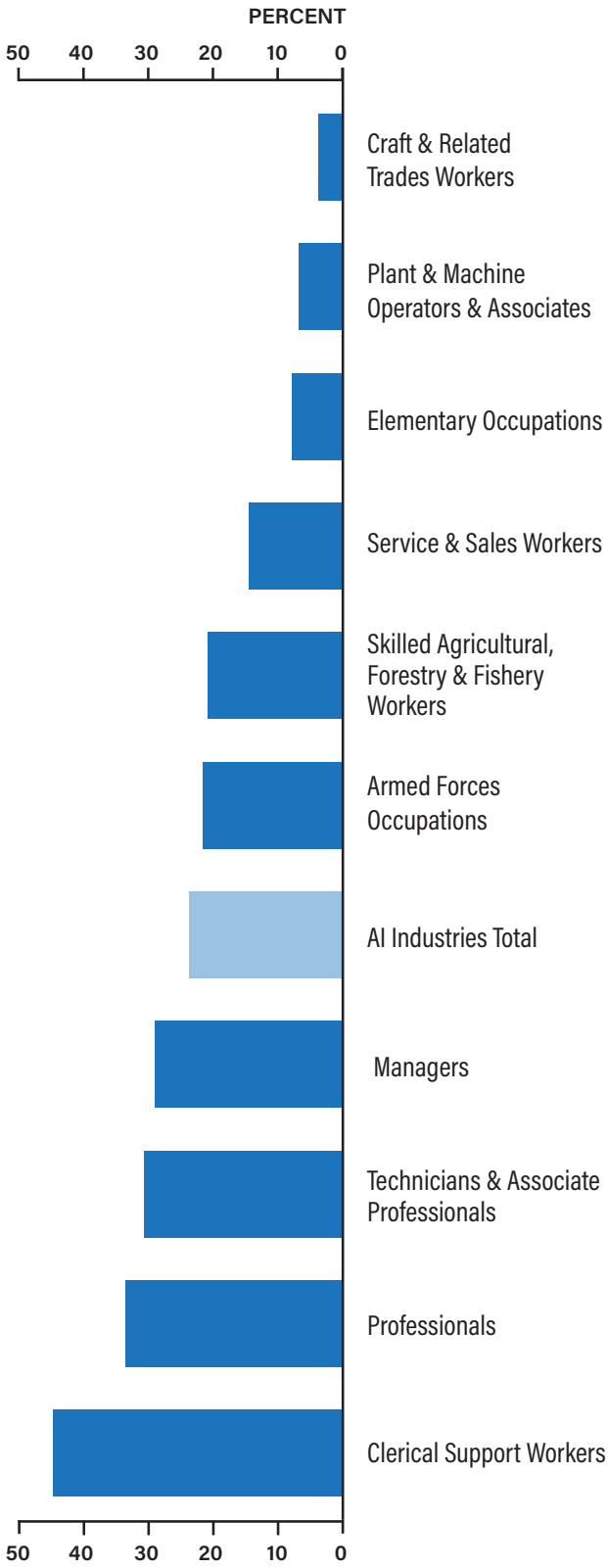
AI is also greatly accelerating drug design using genomic data and then speeding up trial diagnostics and testing, as well as improving inventory management and claims processing.

AI Increasing Value, Lowering Costs

Every other industry and major organization is using AI now to lower costs and increase value. Governments employ AI to manage forms and process citizen requests quicker. Robotic Process Automation, which automates routine office tasks, is now in use in almost every state government. While the deployments are currently limited, in 2017 the Brookings Institute published that 45 percent of all work in government could be automated—using technology that was available five years previous.[iv]

Today's AI is much more effective in comparison, showing that AI can automate much more bureaucratic

Share of Industry Employment Exposed to Automation by AI in the Euro Area



workload, rendering government services far more efficient and responsive at greatly reduced cost.

The energy industry uses AI to manage power loads. Every day, multiple power companies across the country have AI systems that ingest terabytes of data about energy utilization and then distribute power accordingly to avoid spikes and outages. This decreases maintenance costs across the distribution ecosystem and lowers energy costs. AI also helps to balance environmental concerns with energy generation. This improves the ability of a power company to manage both generation and transmission while meeting environmental goals.

Retail businesses use AI to streamline checkouts and ultimately enable you to simply walk into a store, fill your cart and walk out. No checkouts, ever. AI also helps retailers understand where to physically put products in stores and how to provide more accurate advertising.

National defense is completely dependent on AI today. For several years, our cybersecurity defense has been driven by AI all day every day, fending off vast numbers of attacks from enemies around the globe. In North Dakota, government agencies, including the military, ward off 4.5 billion (yes, billion) attacks per year from state actors such as North Korea, Russia and China. That's about 1,100 per attacks per minute against our state's systems. North Dakota's cybersecurity ranks among the most advanced anywhere, defending against 99.999999 percent of attacks through automated tools leveraging AI.

Agriculture is also using AI every day to forecast the weather and for what is now called precision agriculture. This involves AI-enabled photography and other sensors on farm equipment, as well as drones and satellites, to more accurately spread fertilizer, spray weeds, match plant species with soil, decrease chemical and topsoil runoff into streams and rivers, and optimize data input for crop insurance. In short, AI greatly helps farmers increase crop yields with less water, fertilizer and chemical usage at less cost and significant benefit to the environment.

What impact will all this automation have on the workforce? What has it done already over the past 10 years of implementation? It has freed people from commodity, repetitive, predictable, mundane, boring work and let them focus on work of higher value to their companies and themselves.

Jobs Lost but Bigger Gains

Many media pundits and industry experts say that AI progress will go from being an enabler into an economy destroying system. Goldman Sachs predicts that 25 percent of work tasks will be automated by AI, and almost the same proportion of jobs will be replaced.

Will there be a disruptive period of change? Yes, absolutely, and change doesn't come without pain. But

ultimately, history has demonstrated the world will be more productive, and standards of living will increase.

An MIT study of automation showed that from 1947 through 2016, 32 percent of all jobs disappeared but had a reinstatement of 29 percent. "Reinstatement" is a term for jobs created from changes in process. While a large number of jobs were eliminated, new jobs sprung up around the new capabilities.

The ability to build homes to immense skyscrapers grew exponentially once we stopped employing thousands of workers with shovels and instead used bulldozers and other equipment. What happened to the displaced workers? Did they just sit down and die? No, they learned to drive bulldozers or otherwise reskilled. Our education system adapted to the changing times. No one now would want to return to the days of outhouses, medical care via leeches and candles for lighting. Technology completely transformed the world then as AI is doing today.

According to the U.S Bureau of Labor Statistics, the percentage of low-skilled workers has dropped 5 percent just in the past 10 years.[v] At the same time, we have seen unemployment continue to drop under 4 percent (common considered full employment) and the workforce participation rate

History Says People Figure It Out

Many experts predict that accountants will be one of the first white-collar jobs to be fully automated. Perhaps, but I predict that accountants will be able to shift into a new collection of jobs. Each of these positions, in this illustration, requires skills that are very similar to those of an accountant. Relatively minimal retraining will be needed and, like other white-collar workers, former accountants will thrive in this evolving AI economy.[vi]

The growth of computer and internet use since 1995 has completely changed the way we work. App developers didn't exist in 2007. Data Scientists, social media managers, automotive robotic technicians and many other occupations were created only a few years ago. The top-10 fastest growing and most well-paid jobs today didn't exist a decade ago. AI will continue this positive revolution and growth, which includes the continuing disappearance of jobs that no one wants to do because they are boring and don't make people feel good about themselves. In the end, mundane work will be done by computers. You will be freed to pursue more interesting and higher valued careers.

While 10 years ago, data barely existed on AI jobs in the U.S., today there are almost 800,000 open, AI-related jobs across the country,[vii] most of which didn't exist five years ago. While it is true that AI will continue to encroach on more jobs over the next decades, employees who engage in continuous learning and adopt a growth mindset will always be in demand.

In 2018, McKinsey & Company, a leading global management consulting firm, predicted that AI will add $13 trillion to the world economy by 2030.[viii] In my opinion, based upon the last two years of observations from companies Bisblox works with, AI will likely add closer to $25 trillion to the global economy by 2030. AI is leading to vastly higher productivity in a world with a shrinking workforce. This will result in better paying and far more engaging careers for everyone willing to continue learning and adapting to the changing AI economy.

Over the long term, however, government is the primary caveat that might push AI away from empowering people and towards becoming an authoritarian oppressor. Rather than protecting people, governmental regulations often enable big corporations to maximize profits and control, and this could completely upset free markets and ultimately destroy jobs instead of creating them.

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CONTRIBUTORS

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DAKOTA DIGITAL REVIEW

As Oscar Wilde wrote in *The Soul of Man,* **"The difference between literature and journalism is that journalism is unreadable, and literature is not read."**

At Dakota Digital Review, we endeavor to offer highly readable journalism by informed experts in the cyber sciences and related disciplines. Regarding literature, we are open to publishing stories, essays, poetry and excerpts from novels that focus on digital technologies and their implications.

We encourage readers to contact the editor (see below) with comments, criticisms and to submit letters to the editor for publication.

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TechND was founded in 2000 by North Dakota's business, government and education leaders to address workforce needs, advocate for a positive business technology climate, encourage infrastructure development and provide knowledge-sharing opportunities for its membership.

TechND's strategic initiatives:

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