PRISM



2026

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140 years

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BETTER QUESTIONS

Dear Readers,

As Arthur D. Little celebrates its 140th anniversary, we are pleased to introduce this collection of selected articles published under our PRISM banner this year.

PRISM has an exceptional history of its own. First published as a twice-yearly print magazine in 1988, for nearly four decades it has brought together rigorous thinking and real-world experience to explore developments in technology, business, and strategic management — and what they mean in practice.

Last year marked a new chapter for PRISM as it evolved into a dynamic digital platform, while staying true to its original purpose: to challenge conventional wisdom, explore what's next before it becomes obvious, and help make sense of complexity. Each article offers actionable lessons to help leaders anticipate, innovate, and transform.

For a firm founded on the belief that progress starts with asking better questions, that purpose feels particularly appropriate in our 140th year.

And there is no shortage of questions today. AI is reshaping business, society, and the way we work, creating significant opportunities alongside new risks and uncertainties. At the same time, leaders are navigating geopolitical and economic shifts, the energy transition, climate change, as well as profound transformation across many of the industries they serve.

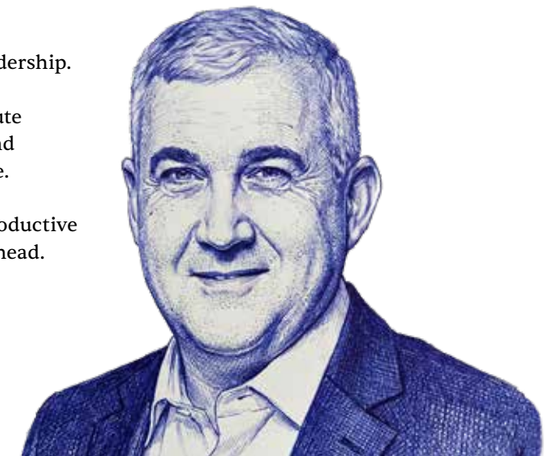
The breadth of this collection reflects that environment. It ranges from AI and automation to energy and climate, and from aviation, automotive, and rail to fundamental questions of strategy and leadership.

Success increasingly requires leaders to be ambidextrous — resolute in driving productivity and efficiency, while remaining curious and ambitious enough to challenge the status quo and build the future.

We hope this collection will stimulate your thinking and spark productive conversations as you navigate the opportunities and challenges ahead.

Ignacio García Alves
Chairman & Chief Executive Officer

"AI is reshaping business, society, and the way we work, creating significant opportunities alongside new risks and uncertainties"



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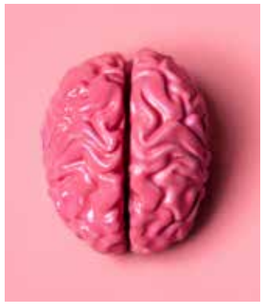

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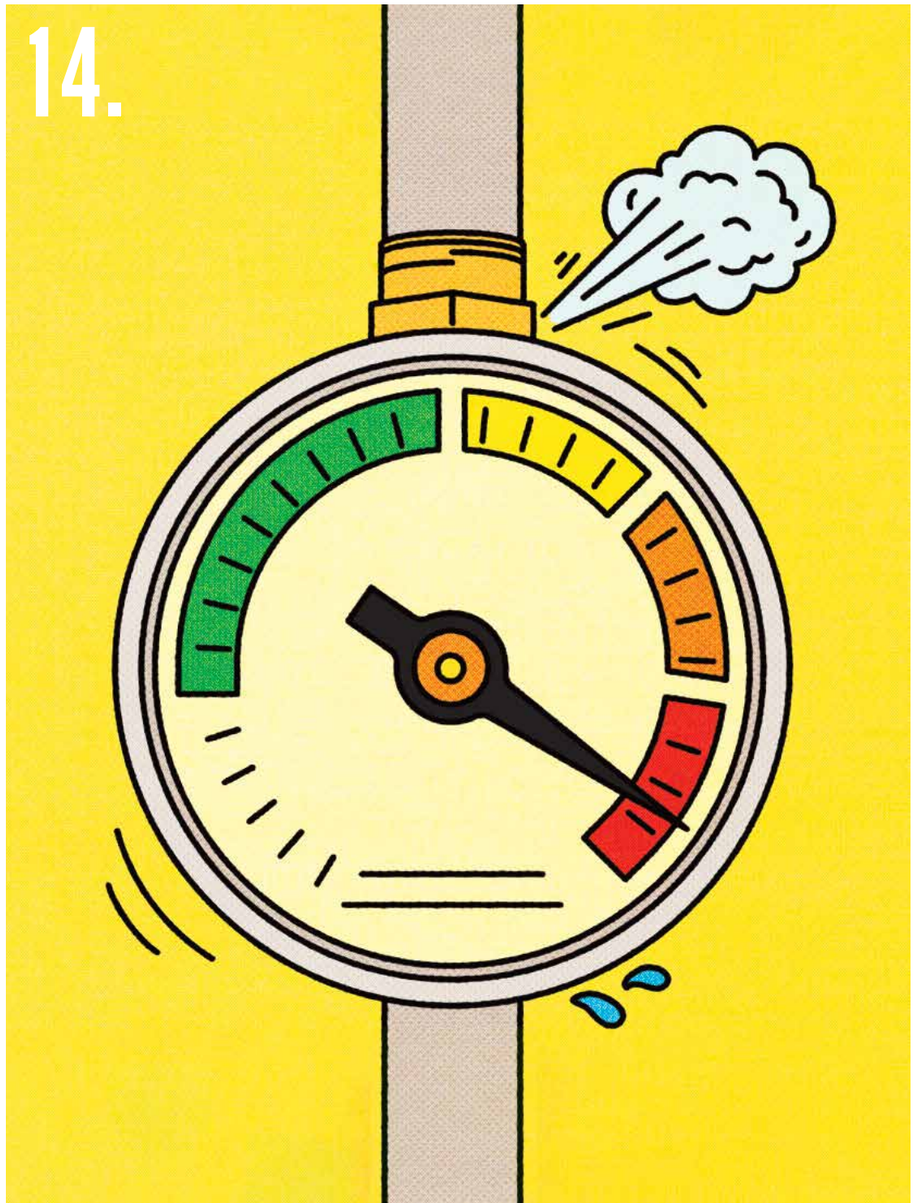

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MIND THE GAP

As AI commodifies certain forms of cognition, human capabilities like critical thinking and initiative become more valuable. One key is bringing different forms of intelligence together.

By Jenny Blair



Consider a group of forthright new hires who quickly spot longstanding problems in their training materials. Unafraid to speak up, they alert their employer to what they've noticed — then rewrite the materials themselves within a week, saving the company money. Another employee, an unconventional thinker assigned to review old warehouse protocols, finds it hard to ignore when a system doesn't make sense. The company credits him with huge improvements to their operations.

The risks of relying on AI without sufficient human judgment can be significant. Companies that deploy AI without adequate human oversight can expose themselves to reputational damage — for example, when customer-facing bots are manipulated into producing offensive or discriminatory responses, or when AI-generated material is published without rigorous fact-checking.

As companies offload more cognitive tasks to AI, people who question, notice, and act on what others miss may become increasingly valuable. Those capabilities can help companies get more from AI while guarding against its risks.

THE PATH TO AI PRODUCTIVITY GAINS

Companies are investing heavily in AI, but many have yet to translate that investment into significant improvements in business performance. It's still early, and much of AI's promised economic value remains unrealized.

But Albert Meige, Director of Blue Shift at Arthur D. Little (ADL), predicts companies will eventually climb the J-shaped productivity curve. Gains will come, he says, when companies redesign workflows around cognitive work that can now be delegated to AI. Central to that redesign, he argues, will be preserving the human capabilities that AI cannot readily reproduce.

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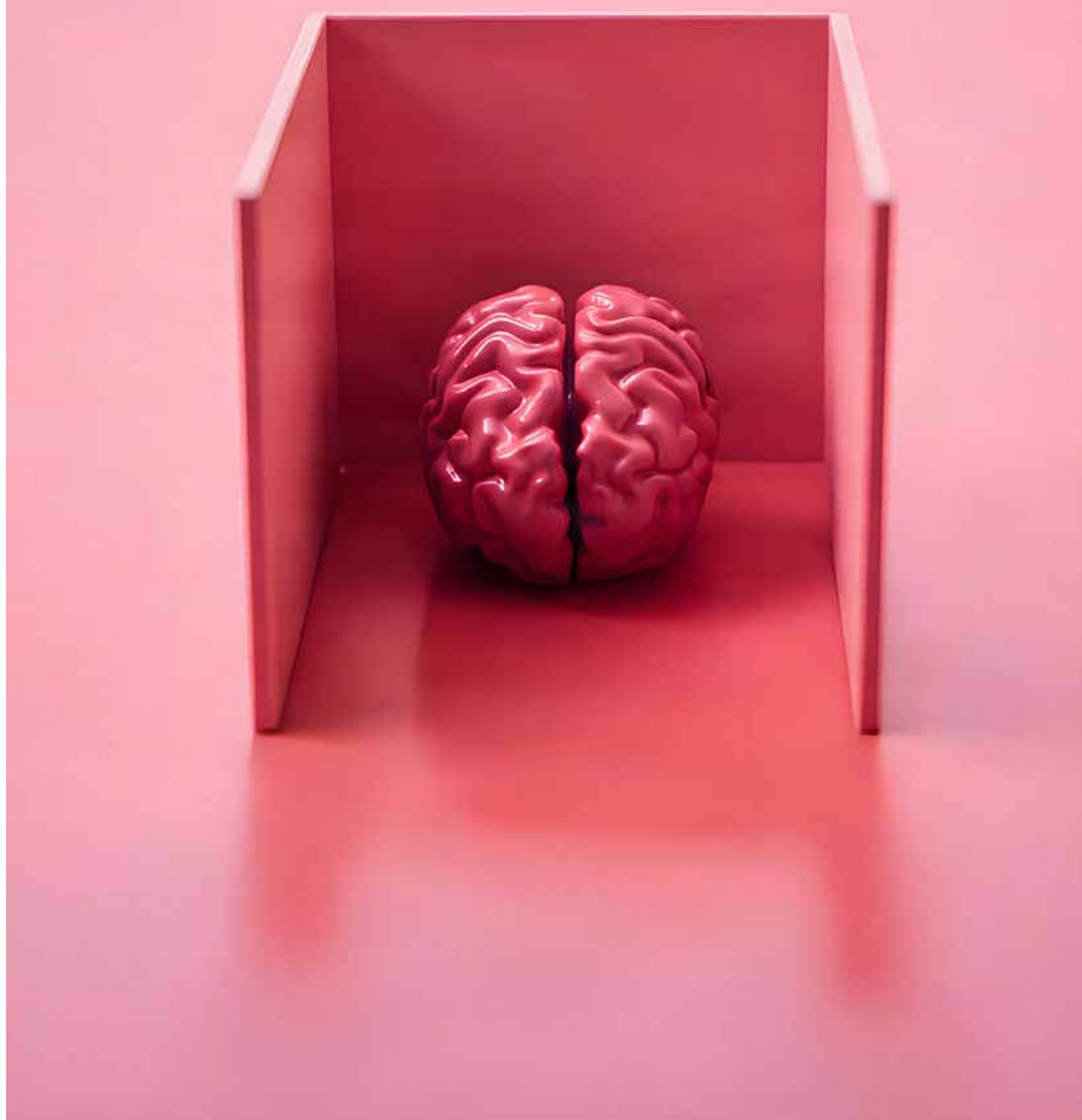
AI stands to turn certain kinds of cognition into abundant commodities, Meige notes, but widely available capabilities offer little differentiation when competitors can access them, too.

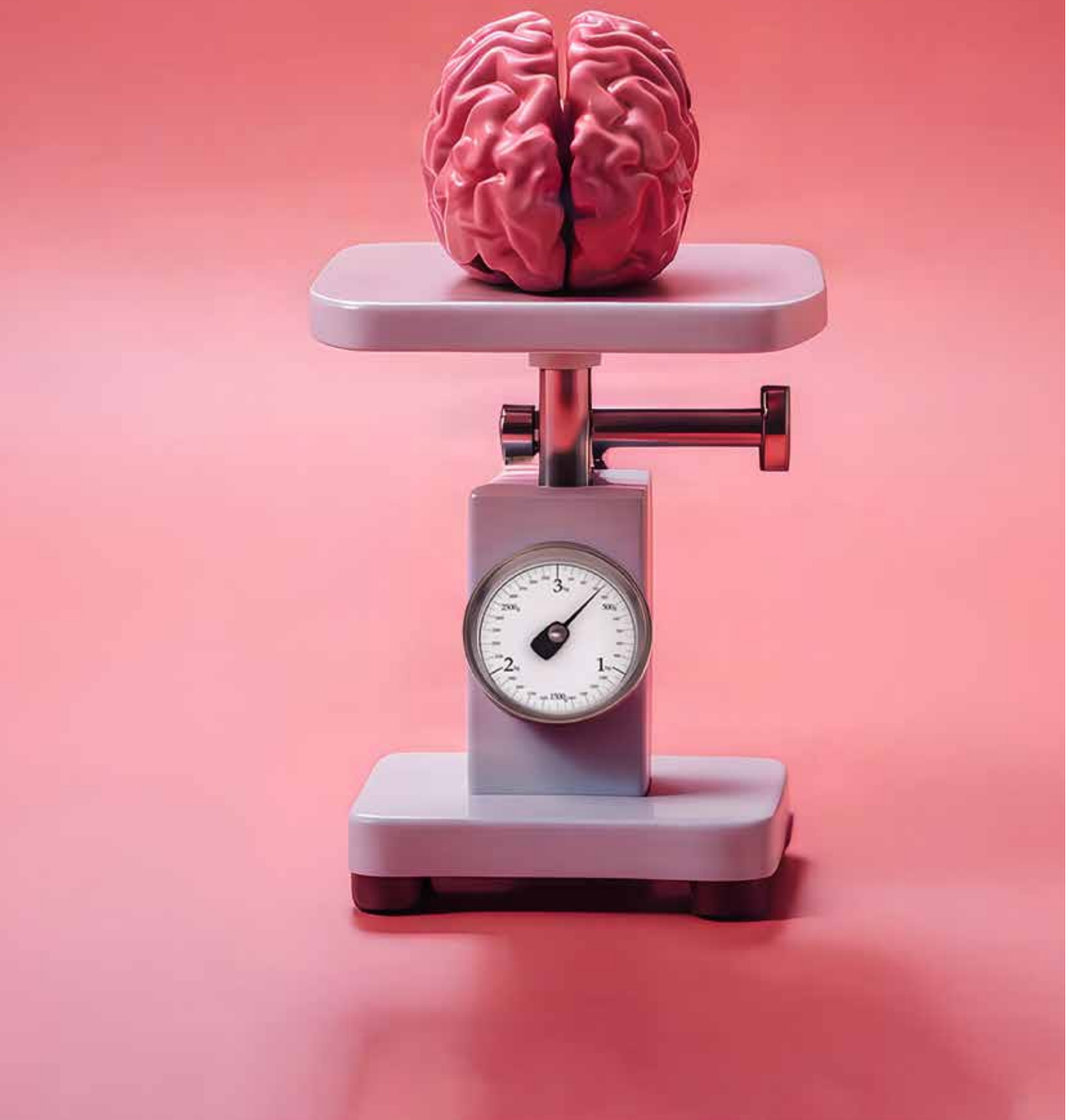
Instead, Meige argues that the difference will increasingly be made by what companies don't farm out to AI. The new scarcity lies in human initiative and the judgment required to wisely deploy AI. Cultivating human agency, cognitive diversity, and proprietary intelligence may therefore become a source of competitive advantage.

WHAT WE LOSE WHEN WE ADD AI

As AI looms larger in the workplace, the risks of delegating too much cognition are also becoming clearer. What Meige terms the AI "convenience trap" for organizations has three parts. Leaders lose decision-making capacity and accountability. Uniformity and lack of marginal perspectives start to affect companies that use the same AI models trained on the same original data. And employee de-skilling becomes commonplace.

Growing evidence suggests heavy AI reliance can erode human critical faculties. A 2025 study in *The Lancet Gastroenterology & Hepatology* examined what happened to human expertise after four medical centers introduced AI tools to detect polyps during colonoscopies. After endoscopy providers began using AI, their ability to detect polyps without its help sagged significantly. A 2025 preprint by MIT researchers reported on brain connectivity among essay writers relying on either a large language model (LLM), a search engine, or their own brains to complete a task. The researchers found the weakest brain connectivity among users relying on the LLM, reporting, "Cognitive activity scaled down in relation to external tool use." (The research has not yet been peer reviewed.)





Trade-offs with cognitive offloading aren't new, as anyone can attest who memorized dozens of phone numbers in the 1980s and now finds themselves dependent on a digital contacts list. Researchers have documented declines in the ability to navigate without help among people who rely on GPS. Engineers who used slide rules, which require users to understand orders of magnitude, noticed people lost a deep feel for the numbers once electronic calculators took over.

But as AI tools grow more capable and we delegate more deliberative thinking to them, there may be more going on than the familiar trade of skill for convenience.

A 2026 Wharton School study described a phenomenon of cognitive surrender, in which people passively accept AI outputs with little critical judgment, overriding their own intuition and deliberation. The researchers framed this as a design and education challenge: how to capture the benefits of AI-assisted cognition without sacrificing critical thinking and accountability.

ADL has found related results. In a recent experiment, the company found that time-pressured employees who used AI to create a presentation had a poorer grasp of their topics than when they didn't use AI, according to ADL's Chairman and CEO Ignacio García Alves. As he puts it, "The tool can make you lazy."

AVOIDING THE AI CONVENIENCE TRAP

Avoiding that trap, Meige argues, requires three mutually reinforcing pillars: human agency, proprietary intelligence, and cognitive diversity.

Human agency inheres in the ability to make well-considered decisions, and leaders must be "architects of intent," in Meige's words. This means deliberately thinking problems through before turning to AI, clarifying intentions, and reducing the risk of anchoring bias. It also means remaining fully accountable for decisions, including those informed by AI.

This has implications for the talent pipeline. Because it's often good at entry-level thinking tasks, AI may seem to make junior employees less important in the short term. Yet jettisoning those workers would create a lost generation, García Alves points out. Without them, who will make expert judgment calls about AI output in the coming years?

"The fact that you combine that AI system or the junior person with a senior person that has experience is extremely important," García Alves says. "If there is this hole in the pyramid, what do you do?"

Proprietary intelligence starts with a limitation: much of what AI knows comes from information that has already been recorded. Humans can find fresh information

"In our business, if you want to be creative, if you want to create collective intelligence and diversity, we need to have people who think differently"

beyond AI's reach by engaging with experts. They can also learn through fast, iterative experimentation, Meige notes, creating original data and insights that do not yet exist in AI training sets.

Cognitive diversity, the crucial third pillar, emerges from disagreement, perspectives that resist easy reconciliation, and from the disciplined process of arguing ideas into stronger conclusions, according to Meige. It counteracts the gray sameness that can settle over organizations whose AI tools draw on the same pools of information.

What does cognitive diversity look like? According to García Alves, it means combining as many types of intelligence as possible, including AI, experts, and colleagues from a wide range of backgrounds.

"In our business, if you want to be creative, if you want to create collective intelligence and diversity, we need to have people who think differently," García Alves says. "We have engineers, and we have people with a business education. We might have people with an art education. We might have people from different countries. We might have people that are autistic, et cetera."

Combining people of differing ages and experience levels also matters. Demand for senior people is higher now, García Alves says, and value emerges when well-seasoned senior and tech-native junior employees work together with AI.

Generative AI (GenAI) can be good at brainstorming new ideas, notes Rob Austin, a Professor of Digital Innovation at Ivey Business School and former chair of Harvard University's CIO executive program. Austin studies what he terms "divergent intelligence," which he defines as an organization's capacity to maintain sufficiently broad and independent viewpoints to recognize value in unfamiliar forms.

But AI's tendency toward sycophancy might weaken its ability to pursue peripheral paths or spot the value in unconventional ideas, Austin notes. That's a weakness it shares with many humans, he adds.

"There is this kind of fundamentally human problem associated with seeing value, even when we succeed in creating it," Austin says. "And that's, I think, where things like divergent thinking come in."

WELCOMING & VALUING NEURODIVERSITY

One source of that divergent thinking is neurodiversity, such as autistic employees and those with attention deficit hyperactivity disorder (ADHD). Research from Harvard Business Review suggests neurodiverse teams that include at least one neurodivergent person can outperform neurotypical ones.

Austin thinks both GenAI and neurodiversity can help maintain divergent intelligence within a company and overcome pressure to conform. The employees described earlier in this article, for instance, were hired through an autism hiring program. They were willing to point out what others didn't.

But hiring for cognitive difference is not enough. Inclusion must be explicit and constructive, going beyond simply hiring neurodivergent employees, if companies are to benefit from those perspectives.

Welcoming neurodivergent employees means examining and redesigning features of organizational life usually left implicit, Austin says. For example, organizations might send meeting agendas in advance, offer virtual participation, or allow employees to contribute through chat rather than requiring everyone to participate in the same way.

Another key tactic is asking all employees how they work best — how they prefer to receive feedback, whether they are derailed by interruptions, and other usually implicit features of the work environment — and then interacting according to their needs. Austin cites New York City engineering firm Ultranauts, three-quarters of whose professionals are autistic, as a company that has built this type of inclusion into its foundations.

Austin says the broader goal is to make explicit the workplace assumptions that usually go unquestioned and design around differences in how people work.

HOW COGNITION WILL MAKE THE DIFFERENCE

The practical challenge, then, is not merely preserving these forms of human cognition but continuing to develop them.

Valuing and nurturing expertise may be especially important because it takes expertise to evaluate AI outputs — particularly on complex questions. Harvard Business School researchers have described AI as a "jagged technology frontier," with its strengths and weaknesses varying in nonintuitive ways relative to those of humans.

"It's very difficult to draw a line and say 'Outside this, don't use GenAI. Inside this, do use GenAI,'" Austin says. "Our intuition and the way we categorize problems doesn't align very well with what GenAI is good at or bad at. Moreover, it's a moving target, because GenAI is getting better at things."

For now, García Alves calls for explicit instruction in higher-order thinking skills — reflection, synthesis, judgment, understanding of context — so employees learn to challenge AI outputs as a matter of course.

"We need to train the junior person to be a little bit critical, so that they always say, 'Does that make sense?'" García Alves adds.

Because AI's capabilities are uneven and constantly changing, Austin argues that people closest to the work also need room to experiment with it.

"You have to actually try it to know whether it's going to work well," Austin says. "Put the tools in [workers'] hands and let them figure out … what it's good at, what it's not good at."

For CEOs, the emerging challenge is not simply deciding what to automate, but determining which human capabilities need to be preserved and strengthened alongside AI. As AI itself becomes more widely available, competitive advantage may increasingly depend on how organizations combine it with judgment, expertise, initiative, and cognitive diversity — and on which forms of cognition they deliberately choose not to outsource. ■

As AI looms larger, the risks of delegating too much cognition are becoming clearer

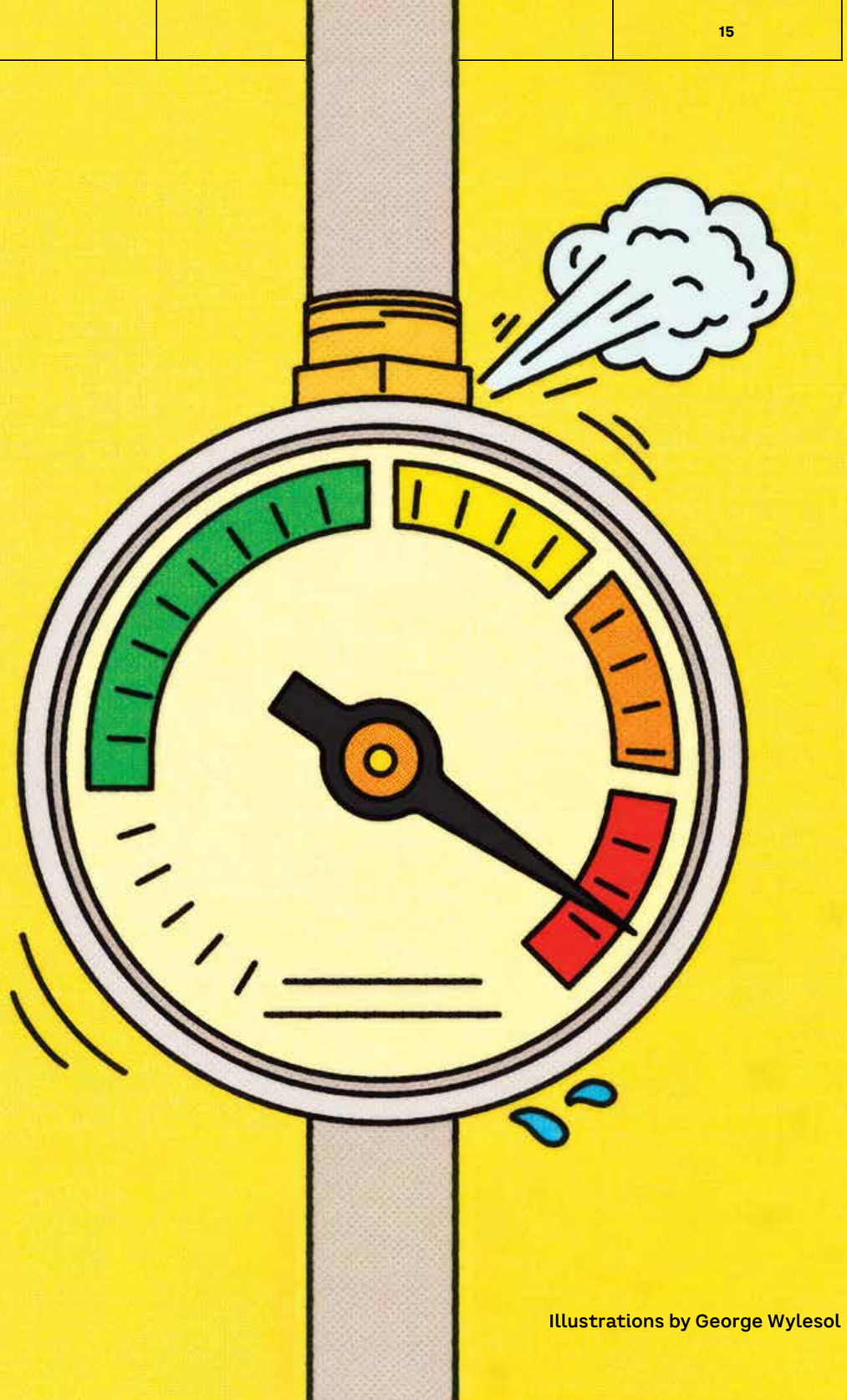
Jenny Blair is a US-based former emergency physician turned journalist and writer covering science, medicine, culture, and more. Her work has appeared in mainstream publications, including *New Scientist* and *Discover;* independent newspapers such as the *Austin Monitor* and *The Bridge*; and professional outlets, including Medscape, Medtech Insight, and WebMD.

KEY TAKEAWAYS

- **Make human judgment your competitive edge.** As AI takes on routine thinking, keep strengthening human judgment, initiative, and higher-order thinking.
- **Don't fall into the AI convenience trap.** Overreliance can erode expertise, accountability, and independent decision-making.
- **Build what AI can't commodify.** Invest in human agency, proprietary intelligence, and cognitive diversity as sources of differentiation.
- **Seek out thinkers who see what others miss.** Differences in neurotype, background, age, expertise, and thinking styles can challenge groupthink and uncover overlooked opportunities.

WILL AN ENERGY CRUNCH STOP THE AI REVOLUTION IN ITS TRACKS?

AI looks weightless, but it runs on power. As data centers scale and the energy transition accelerates, the limits to AI's growth are becoming sharply real.



By Mike Scott

Since the launch of ChatGPT, AI's growth has appeared inevitable and unstoppable, with the world's biggest companies throwing billions of dollars into creating the world's newest infrastructure. Because it lives mainly in the cloud and on our screens, AI appears to be a benign, almost weightless extension of the internet, removed from earthly concerns like energy use, bricks and mortar, and resource availability.

But the AI revolution is running up against the physical realities of electric power, water, rare earths, and electricity grids. There is an exploding demand for energy, driven by AI, the cloud, and the digital economy, as reported in ADL's recent Blue Shift report "AI's Hidden Dependencies." Simultaneously, the energy transition is accelerating the growth of intermittent renewable energies, increasing the pressure on energy grids.

WHEN MEGA-TRENDS COLLIDE

"AI is changing how the economy will be driven and the way we work — and the energy requirement is huge," says Luis del Barrio, Partner in ADL's Energy, Utilities & Resources practice.

These mega-trends are colliding, del Barrio explains. The energy transition has been driving a move toward a decentralized power system that, in many countries, is dominated by intermittent renewable energy sources and, ultimately, storage that prizes flexibility over always-on baseload power. But the digital economy, and AI in particular, has a seemingly insatiable appetite for reliable 24/7 power — and little flexibility to change that. "Reliability will be king in the new AI world," says del Barrio.

This is not just an issue for data center operators. Problems at these facilities can cascade across the global economy, as the AWS outage in October 2025 showed. The failure, at a hub in Northern Virginia in the US, disrupted 10,000–30,000 websites, affecting government systems, financial apps, and social media platforms worldwide.

As the computational intensity of AI training and inference (putting that training to work to perform real-world tasks) surges, energy consumption and resource use by data centers could grow fivefold, and their emissions could double by 2030, according to the previously mentioned ADL Blue

Illustrations by George Wylesol

Shift report. "Every AI model rests on a substantial industrial backbone of rare earths, manufacturing, electricity, and water," the report notes. Dependence on these resources makes the sector vulnerable to issues that could affect future growth, including the availability of energy and compute infrastructure and environmental impacts.

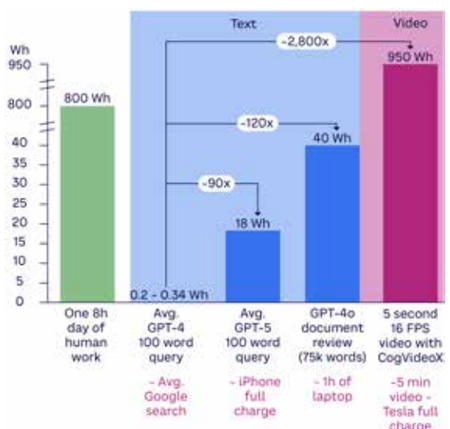
Global data center capacity is about 50–60 GW on average and predicted to reach about 130 GW by 2028, with investment in data centers approaching US $1 trillion by 2030. According to the International Energy Agency (IEA), the sector's electricity use is expected to double to 3% of total demand by 2030.

A key challenge for AI is that — just as the sector as a whole is scaling up extremely quickly — individual data centers are also expanding. Facilities built pre-2020 averaged tens of megawatts; today's facilities can be 100 MW. Several 300–500 MW facilities are being built, and a number of gigawatt-scale data center campuses are under construction. (For more on the influx of global giga-scale data centers, see ADL Viewpoint "Giga Scale: The AI Infrastructure Gold Rush.")

This massively increases the amount of energy, land, and water they need. Some large data centers can draw down as much water each day as a medium-sized town, and operators are increasingly having to install closed-loop liquid-cooling systems, adding to the cost and complexity of their facilities (see ADL Viewpoint "Unlocking Cross-Industry Value: Strategic Ways to Enhance Data Center Power Needs").

Because facilities are concentrated in certain areas, that 3% of global electricity demand is unevenly distributed. Northern Virginia hosts more than a third of global hyperscale data centers, and some studies suggest these facilities could account for 30%–45% of the state's electricity demand by 2030. In Ireland, more than a fifth of the country's electricity powers data centers.

AI'S ENERGY DEMAND WILL INCREASE EXPONENTIALLY AS TASKS INCREASE IN COMPLEXITY



Source: Arthur D. Little, EpochAI, *MIT Technology Review*, expert interviews

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THIRST FOR POWER

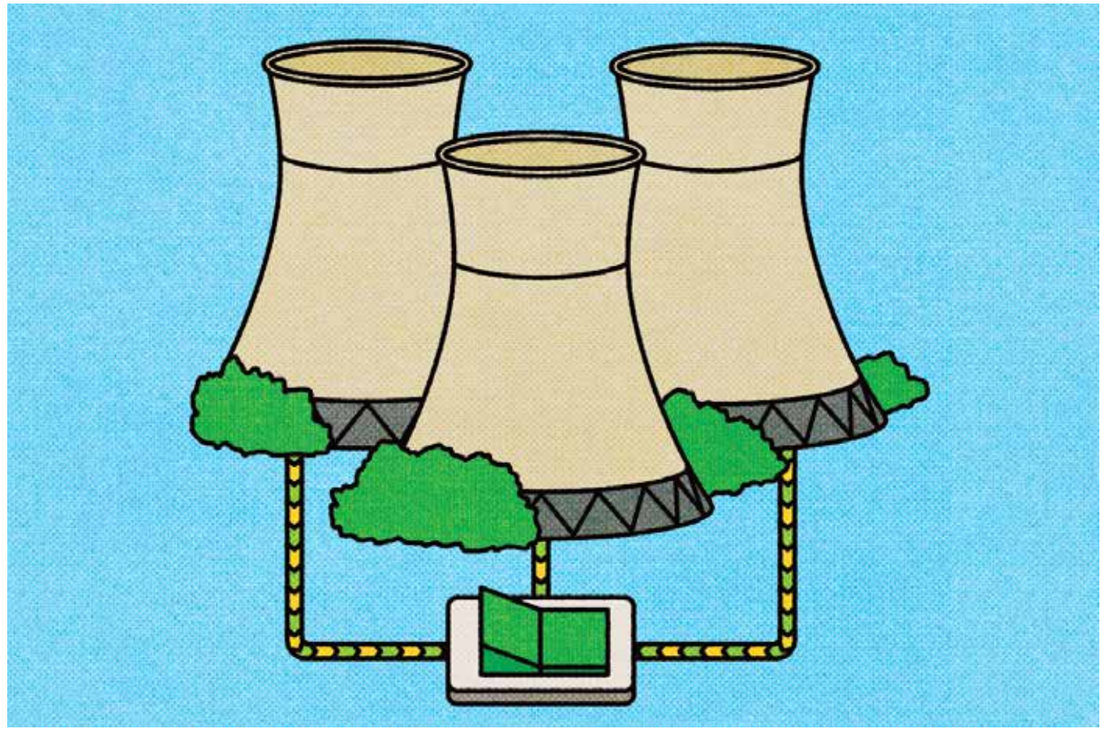
AI and digital power demands are running up against demands from other industries and societal requirements. This will affect the industry's ability to continue growing without restraint and may affect its social license to operate. "In Dublin, one of the main data center locations in Europe, energy consumption from the sector is so high that there is a moratorium on developments for the foreseeable future," says Lars Riegel, Partner with ADL's Telecommunications, IT, Media & Electronics (TIME) practice.

The *Financial Times* reports that "US data centres developers are flooding utilities with inflated growth plans, muddying efforts to plan for future power needs with projects that may never materialise. Developers are approaching multiple utilities with the same project in a quest to find the lowest-priced power, leading to so-called phantom data centres."

In response, utilities are tightening rules and changing pricing structures to ensure that other customers do not end up paying for data center infrastructure development. This has led to data centers becoming increasingly dispersed, with hubs springing up in Milan, Madrid, the Nordics, and Eastern Europe.

Michael Liebreich, energy analyst and founder of Bloomberg New Energy Finance, says hyperscalers have suffered a rude awakening. "Suddenly these masters of the universe said, 'Wait a minute, well, there isn't enough electricity,' and they were most annoyed because something as prosaic as electricity was going to get between them and their intergalactic ambitions."

AI companies are having to integrate resource efficiency into their thinking, so the locus of innovation will switch to efficiency, Liebreich explains. They are also on the hunt



for new sources of low-carbon baseload power, although they are sourcing fossil fuel energy as well, increasing emissions just as many other parts of the economy are decarbonizing. Such is the sector's thirst for power that it has contributed to a global shortage of gas turbines, which is slowing the addition of the generating capacity it craves.

IS NUCLEAR THE ANSWER?

The AI sector is one of the main drivers of a renewed appetite for nuclear power. This stems from (1) its ability to provide power that is low-carbon and consistent, and (2) favorable lifecycle costs for plants and grids. Companies, including Microsoft and Meta, have sought to restart shuttered nuclear power plants or extend the life of existing facilities. Companies like Alphabet and Amazon seem more interested in small modular reactors (SMRs). These have an output of 300 MW or less and are, in theory, faster to build (they can be assembled in factories offsite), less expensive, and safer than utility-scale plants (see ADL report "The Growth & Future of Small Modular Reactors").

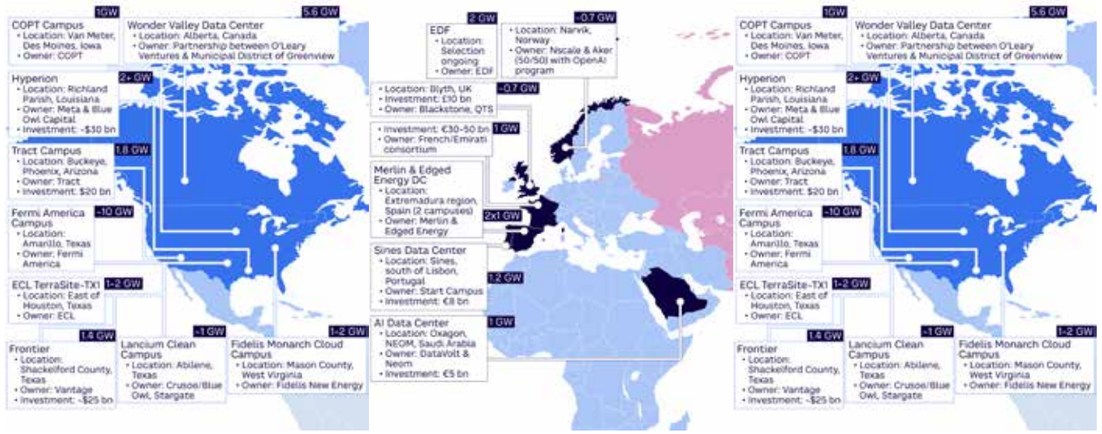
Traditional engineering companies such as GE/Hitachi and Rolls-Royce, as well as China's CNNC (China National Nuclear Corporation), are working on plants that are fairly close in concept to today's large-scale light-water reactors. The first commercial light-water SMRs are expected to come online around 2030. China is commissioning a pre-commercial plant (the ACP100) that is due to come online in 2026.

"But the large tech companies are working with companies such as Kairos and X-energy, which are trialing different designs that (if everything works out) have a number of advantages over light-water designs," says Michael Kruse, Managing Partner for ADL's Energy, Utilities & Resources practice.

The coolants used in these reactors need less water, making it easier to get approval to build plants in water-stressed areas. They also use innovative fuels that produce much less waste, making it easier and less expensive to manage and dispose of. They have advanced safety features that require a smaller emergency planning zone, so reactors can be built closer to where they are needed.

"This makes it easier to colocate data centers and SMRs and to build facilities with a smaller footprint," says Kruse. "If the industry relies

GIGA-SCALE DATA CENTER ANNOUNCEMENTS



Source: Arthur D. Little, DCD, Morningstar, press releases, company announcements, Semafor, Reuters

only on electricity networks and renewables, the rollout of AI will be delayed because there will be competition for energy from EV charging, industrial electrification, and other sources."

NUCLEAR CHALLENGES

However, there are more than 90 innovative reactor designs being explored, says Kruse. "There is no global harmonization on designs, licensing, or supply chains. There will need to be a shakeout: the world can only sustain five or 10 dominant SMR designs because we need mass production to bring down costs. But where nuclear power was previously driven by government interests, it is now being driven by tech companies."

The sector has a history of escalating costs and overruns, he notes. "And if you build hundreds of data centers and SMRs in remote, isolated locations or emerging countries, you are going to run into significant issues around both nuclear safety and physical/cybersecurity."

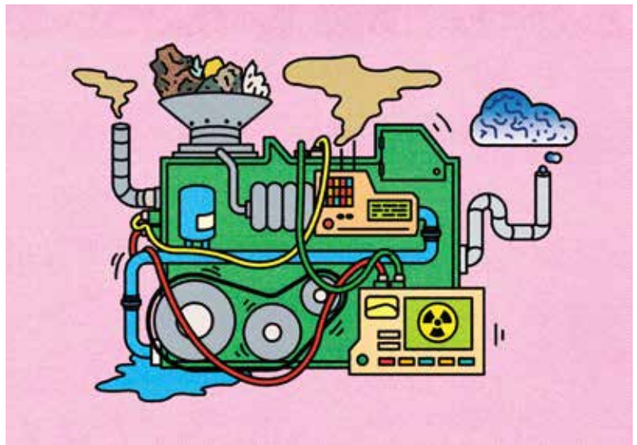
Liebreich sounds a further note of caution as to why nuclear may not be the answer to the sector's problems: "They're going to find it's complicated. It's slow. When one of those reactors goes down, all of them have to be pulled offline to check the cracks or whatever it is. They're going to find it very hard."

There are serious constraints to growth around grid networks, too, which are aging and experiencing increased congestion due to renewables. Experts point out that although AI may appear global, its expansion depends heavily on local grid capacity and connection speed. In parts of the US and Europe, projects are waiting up to seven years to get connected, delaying projects despite available capital.

MORE TRANSPARENCY NEEDED

AI and data centers have grown so quickly that it is increasingly difficult to know how much energy the sector is using. "Since 2024, fewer than 3% of new AI models have disclosed environmental data, down from 10% in 2023," says Sean McDevitt, Partner in ADL's TIME practice. Voluntary disclosure regimes are inadequate, and they fail to create a baseline from which the industry (as well as regulators, policymakers, and investors) can measure improvements in energy intensity.

The above-mentioned Blue Shift report notes: "What we know about AI's footprint is a function of what's chosen to be reported and is incomplete. Even where reporting exists, data is partial, incomparable, or framed to understate impact. Without consistent, mandatory disclosure, its real footprint will remain unknown."



Regulations vary widely from region to region. China has set national targets for data center efficiency and renewable energy use, and under the EU's Energy Efficiency Directive, data centers over 500 kW must disclose their energy and water use, as well as how efficient they are. In the US, there is no federal mandate, so rules differ from state to state.

It is even harder to discern how much energy AI is saving across the rest of the economy. But with the energy crunch intensifying, the sector will have to quantify its energy usage and explain how it helps other sectors save energy if it wants to maintain its social license to operate.

ENERGY-SAVING INNOVATIONS

"Innovations are starting to emerge to limit AI's energy consumption and disruptive impact on other sectors," says Riegel. Chips are becoming more efficient, and creating specialized models for specific tasks makes them more effective. AI training that is not time- and location-sensitive is quite portable. It can be moved to times of low demand or grids with high levels of renewable energy, either permanently by siting data centers in remote locations with a lot of land and low-carbon power, or temporarily, to reduce pressure on networks at peak time and leverage lower power prices or the availability of renewables (see ADL Viewpoint "Hybrid Renewable Ecosystems"). Much of the work can be done directly on devices such as phones or laptops, reducing reliance on data centers.

Given that the geographical concentration of data centers causes strains on specific electricity grids, nonprofit Rewiring America has suggested that hyperscalers looking for quick access to power could pay householders to install heat pumps in regions where they want to build data centers, freeing up the electricity they need. In the US state of Pennsylvania, the group says, data centers will add about 3 GW of new demand to the grid, but 45% of that demand (about 1.3 GW) could be offset just by replacing inefficient electric heating with heat pumps. If hyperscalers subsidized half the cost of heat pumps for households, they could free up capacity at a similar cost to building and operating a new gas-fired power plant while generating consumer goodwill and helping decarbonize the housing stock, the group notes.

NEXT STEPS

The energy crunch is coming, and AI is both a cause and a victim. Companies in the sector can take several "no-regret" actions to ensure they are prepared for the new risks this will create. These include an increased focus on resource efficiency, as well as working to create credible environmental reporting of AI's impacts. They should also engage with transmission system operators (TSOs), not just to gain access to the grid, but to propose innovative ways to free up capacity.

The sector's growth has been characterized by a "throw money at the problem" approach. As it comes up against the physical limitations of power availability, the sector's ability to thrive will depend on how quickly it can pivot to more innovative, sustainable solutions. ■

This article builds directly on the ADL Blue Shift Report "AI's Hidden Dependencies" and draws extensively on its framing, analysis, data, and visuals. We thank the Blue Shift team for the work that underpins this piece.

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KEY TAKEAWAYS

- **AI's demand for energy is coming up against real-world physical constraints that could limit growth.** Both providers and end users should consider how they can reduce these constraints to reduce their exposure to shocks.
- **Grid capacity is as important as power availability.** Data center providers should engage with TSOs to understand how facilities can fit into grid networks.
- **More transparency is needed around AI's energy and resource use.** End users are likely to begin demanding this information as part of their AI procurement process.
- **Nuclear power, especially SMRs, may help to ease AI's energy crunch**, but it may take longer than expected to make an impact.
- **There are quick wins available by cutting energy demand through the development of more efficient chips and algorithms**, as well as by moving AI training to areas and times where power demand is lower or supply is low-carbon.
- **Providers should map their supply chains and diversify their exposure** to increase resilience in the face of potential geopolitical and operational disruptions.



THE POWER OF CUSTOMER-FOCUSED SIMPLICITY

AN INTERVIEW WITH ALEX HYNES

As Britain's railways undergo a once-in-a-generation restructuring, DFTO CEO Alex Hynes explains why customer focus and empowered leadership are key to making public ownership work.

Britain's railways are undergoing a once-in-a-generation restructuring, replacing the franchising model by bringing 14 train operators together under the newly formed Department for Transport Operator (DFTO), integrating track and train units, and ultimately creating Great British Railways (GBR).

Alex Hynes, CEO of DFTO, sits at the heart of this huge transition and reflects on his philosophy for running national rail operations. "One of my weaknesses is that I can be accused sometimes of oversimplifying complex situations, but I genuinely believe that there is power in simplicity. Bringing simplicity to complex situations is part of my method. It all comes down to looking at things through the customer lens," he says.

Alex's career has shaped the way he leads. Originally trained as a transport economist, he quickly realized that he was much better at organizing people and things than being an analyst or a regulator. A self-confessed "franchising geek," he began bidding for rail operation franchises with the Go-Ahead Group before becoming Commercial Director of UK train operating company London Midland at just 30. He soon went on to become Managing Director of Northern Rail. At the time, this was the UK's largest train operating company — but one of the worst performers. In just two years, he successfully turned it around to be among the best.

He later moved to Scotland where for nearly seven years, he was Managing Director of Scotland's Railway, a post-privatization alliance between train operator ScotRail and network manager Network Rail Scotland. "I went to Scotland to get the experience of running infrastructure, running a more integrated railway in the public sector. I had seven wonderful years, loved it."

In April 2024, he was headhunted for a move to the government side as Director General for Rail Services in the UK's Department for Transport (DfT). Alex describes his 21 months as a senior civil servant as an invaluable opportunity to understand how government operates, from working with ministers to navigating decision-making across Whitehall. During that time, he helped introduce a seven-point plan to improve train crew management, contributing to a 50% reduction in cancellations caused by crew shortages. He believes further improvements are still to come.

Right now, as CEO of the intentionally short-lived DFTO, Alex is sanguine about his role. "I started doing this job in December. I've been very fortunate to work with many fabulous people. I've had a few lucky breaks, and here I am!" he says.

MAKING A SUCCESS OF THE NEW PUBLICLY OWNED RAILWAY

The new GBR, which will employ more than 97,000 people, will be under intense media and public scrutiny from the word go. While renationalization of the railways enjoys a majority of public support, plenty of commentators are voicing concerns. Fares are undeniably expensive, yet government subsidies have also increased sharply — from £2 billion in 2000–2001 to £12 billion in 2024–2025.

Nationalization per se won't change these fundamentals. Some commentators fear that GBR could become a ghost of the late, unlamented pre-privatization British Rail. So, what is Alex's view on how to make it work?

"Our job at DFTO is to deliver against the full breadth of the scorecard — it's safety, people, performance, customers, and finances. Bringing train operating companies into public ownership isn't a magic bullet for all the problems facing the railway, but it enables us to integrate track and train, and create single accountable leaders for each geography," he explains. "One of the things that's already working very well is our colocation with

friends and partners down the corridor at Network Rail."

Alex believes success depends on having a simple vision and mission, supported by clear objectives. His mantra while at the DfT was "performance up, subsidy down." Of his task now, he says, "We need to reduce the level of subsidy — we're not being asked to cut costs. Which means that revenue counts."

"The government decided to freeze fares, so revenue growth needs to come from volume. That means we need to give customers a brilliant experience. We need to deliver the timetable the market wants and needs," he says. "Post-COVID, we ended up with a leisure-led railway. But now, the fastest-growing segment is commuting and business. Employers in cities are insisting more and more on five days in the office. There's good potential for volume growth if we get the service right."

LOOKING THROUGH THE CUSTOMER LENS

Alex is very clear about how the public will judge GBR's success, and it's all about the customer experience.

Alex says DFTO is bringing together customer, fares, ticketing, and retail functions to create a single customer experience strategy. The goal is to replace the current mix of passenger charters, compensation policies, and service standards with one consistent customer promise across the network. Citing poor Wi-Fi as an example, Alex says plans are underway to roll out faster onboard connectivity across more mainline services, following encouraging trial results that he believes could be a "game changer."

Making the most of better data and achieving better service consistency are also key parts of Alex's customer experience strategy.

"We now have this thing called the 'Rail Customer Experience Survey,'" he says. "We've always had customer surveys, of course, but this is double the size, and we get data in real time. I've looked at it several times today. We already live and breathe performance, but now we're getting data allowing us to live and breathe customer perception as well. We've never had that before. All of this means we can tailor services accordingly."

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"For UK rail, the average customer satisfaction is actually quite good — around 88%. But the average hides an enormous variation. As we roll out the GBR brand, we need to make sure that the quality is more consistent everywhere," Alex says. "Ultimately, it's the outliers that will affect the national conversation most."

DEVOLUTION IS JUST WHAT WE NEED FOR RAIL

Britain's new Prime Minister, Andy Burnham, is a famously strong proponent of devolution and has openly called for legislation to grant statutory powers to regional mayors. Fortunately, this aligns very well with Alex's own philosophy for the railway.

"One of my leadership philosophies is a strong belief in devolution and holding people accountable. All things being equal, decisions taken close to the customer will be better than decisions taken hundreds of miles away," he says.

"I remind people a lot that mayors want an effective transport system that citizens can take for granted. But outside London, this has eluded us ever since buses were privatized and everywhere was completely deregulated," Alex says. "But now England will have, for the first time, an integrated national transport strategy, a unified national railway, and the government devolving powers to re-regulate buses. These three things will be powerful in creating a joined-up transport system for places outside London that haven't had it for a whole generation."

Alex says legislation should establish the right framework without becoming overly prescriptive. "The message I want to give my business leaders is to strengthen and deepen their relationship with the city mayors because all they want is a transport system that looks more like the one in London. Why would we not want to be a part of that?" he says.

LEADING TO CREATE A POSITIVE CULTURE

One of the biggest challenges ahead is bringing together different organizations, each with their own culture and history. And middle managers are often singled out as the main barriers and blockers. What does Alex think about this?

"I think when senior managers complain about the middle management layer, it's a reflection on them. If you're getting frustrated with the way these people are working, it must be down to the system that's been created," he says. "As senior leaders, your job is to create an environment in which other people can perform."

> **"Bringing simplicity to complex situations is part of my method; it all comes down to looking at things through the customer lens"**

"This means having a simple plan that everyone knows and incentivizing delivery of the plan," Alex continues. "For example, when I was at Northern Rail, we weren't just the worst train operating company for customer satisfaction; we were also the most profitable — which is interesting in itself, isn't it? One of the things I had to do was win the argument with managers that, no, we care about performance, people, customers, and safety as much as profit. So, I put my money where my mouth was and launched a performance-related pay scheme for all managers where they could earn 2% each for people, profit, performance, customers, and safety. In the end, I had a management team that knew what they had to achieve and got rewarded for it."

Alex feels equally strongly about how leaders engage with their people.

"I always try to go to them rather than drag them down to London because I want to see the place, use the product, and avoid the danger as a senior manager where people are saying one thing, but it's not necessarily borne out of reality. I think you need to see and feel and touch railways," he says.

"Also in working with unions. Trade unions are our partners, and actually, on the vast majority of things we agree — we want a successful, growing railway that employs highly skilled, decently rewarded people," Alex says. "Do we have disagreements? Yes, in a few narrow areas, but that doesn't mean a full-scale falling out. I have good personal relationships with all the general secretaries. Informal conversations often help to find the win-win. Talk is work!"

Alex agrees that running UK train operations is in many ways much more complicated than running an independent company. There are 1.6 billion customers per annum, and 17 organizations delivering the service. He sums up his approach quite simply.

"It doesn't mean we shouldn't try to create this customer-focused simplicity — that's what most people don't do. You've got to line the business up, all face the same direction, and repeat it clearly every moment," he explains. "I like to have a simple, clear plan, surround myself with brilliant people, and let them get on with it. I like fixing things because I care deeply about public service. That's what gets me out of bed in the morning."

As our conversation with Alex ended, a famous Steve Jobs quote sprang to mind: "Simple can be harder than complex. You have to work hard to get your thinking clean to make it simple. But it's worth it in the end because once you get there, you can move mountains."

It looks like Alex might be on to something. ■

This interview was conducted by Phil Bulman and Rick Eagar of ADL.

KEY TAKEAWAYS

- **Drive for simplicity,** with clear vision, mission, objectives, and plans.
- **View the business through the customer lens** to focus on what matters most, supported by the best possible real-time data on customer experience.
- **Incentivize delivery** against balanced scorecards to align priorities and reinforce accountability.
- **Empower smart people** and let them get on with it.
- **Go to your teams** — don't always drag them to your office and recognize the value of informal conversations.

JUST ADD AI

TURNING HYPE INTO COMPETITIVE ADVANTAGE

AI is reshaping entire industries, but technology alone won't determine who comes out ahead. The companies that succeed will be those that pair AI with the right people, strategy, and operating model to drive real transformation.

By Sage Lazzaro



Illustrations by Olga Aleksandrova

Companies are pouring billions into AI. They're hiring chief AI officers, rolling out copilot apps, experimenting with agents, and weaving AI into nearly every strategic conversation. AI has been around long before ChatGPT, but the chatbot's launch changed the urgency of the conversation, propelling AI from novelty to business necessity.

Michael Kolk, Managing Partner and Global Practice Leader of the Innovation practice at ADL, says the scale of the shift is hard to overstate. "Today, this ecosystem of AI vendors, AI companies, and solutions is immense," he observes. But beneath the hype, a tough question is surfacing in boardrooms and leadership meetings: is any of this delivering business value?

Many AI investments have yet to translate into measurable business impact. Despite aggressive spending and endless experimentation, companies across industries remain stuck in "pilot purgatory" — running disconnected AI initiatives that generate excitement but fail to scale into operating advantage. Productivity gains are often unclear, employees are overwhelmed by tools that don't fit their workflows, and leaders are realizing that AI transformation is far more complicated than deploying new technology.

Part of the challenge is that applied AI is not one uniform wave. According to an upcoming flagship report from ADL's Innovation practice, adoption is clustering in specific industry and functional hotspots, while the supplier landscape remains highly fragmented. GenAI is an important and highly visible part of that ecosystem, particularly where work is language-heavy, but it is not the full architecture of applied AI. Classical machine learning (ML) remains a major part of the market, and many emerging solutions are in fact hybrid solution stacks that combine GenAI with classical ML and advanced knowledge and data integration.

For executives, the implication is not simply to adopt more AI, but to navigate the ecosystem deliberately: scaling where the market is ready, redesigning work around the technology, building hybrid architectures, governing for scale, and retaining control where dependence would matter most.

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Preliminary findings from the report suggest those hotspots are beginning to come into focus. Financial services, media and entertainment, consumer services, and transportation appear to be among the sectors moving fastest, while functions like operations, engineering, compliance, and marketing are emerging as early leaders in adoption.

But moving fast is not the same as getting value. The companies seeing measurable results aren't necessarily the ones chasing the flashiest use cases. Instead, they're getting a handful of fundamentals right: clean and accessible data, narrowly defined problems, redesigned workflows, and a relentless focus on business impact over experimentation for experimentation's sake. Most important, the leaders who see ROI understand that AI transformation is not primarily a technology challenge — it's an organizational one.

WHERE AI IS MOVING FROM EXPERIMENTATION TO IMPACT

The move from experimentation to impact is happening fastest where companies apply AI to use cases with strong data foundations and clearly defined processes. Kolk points to one chemical company that used comprehensive data to rethink one of its most expensive and time-consuming activities: experimentation. Previously, determining how to create the right chemical for a scenario required repeatedly conducting real-world experiments to narrow down the possibilities. Today, the company uses AI to analyze all relevant data (literature, patents, and experiments run internally and externally) to quickly identify the most promising routes to success. AI is then used to combine such predictive (synthetic) data with those coming from much more targeted physical experiments, which is far more efficient and effective than traditional approaches.

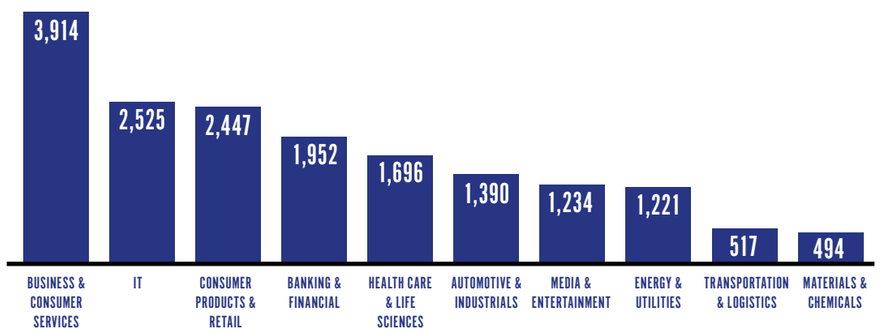
"Not only is physical experimentation costly, it is also time-consuming and often not effective. Having a superior new product in the market faster can easily generate tens of millions of dollars in value," says Kolk.

Another early breakout area is software development, where AI is helping teams move faster on structured, well-scoped technical work, says Michael Papadopoulos, Partner in ADL's Innovation practice and Chief Architect



NUMBER OF AI SOLUTIONS BY INDUSTRY

SERVICES, DIGITAL & CONSUMER DOMINATE





By Tim Stevens

THE ORGANIZATIONAL IMPERATIVE FOR AUTOMOTIVE'S FUTURE

To survive in today's increasingly competitive landscape, legacy automotive manufacturers need to be ready to rethink everything.

of Digital Problem Solving. His own work building software prototypes for the firm's clients offers one example. Over the last 16 months, many of the prototypes Papadopoulos has developed — including applications for regulated industries — have been largely coded using AI, allowing teams to move from concept to working software much faster.

AI currently works best in workflows that are structured, narrow, and repeatable. This can include multistep workflows, as long as there are clear boundaries between steps. For example, Papadopoulos points to a code-review pipeline for resolving customer tickets, in which the workflow follows a consistent pattern and the steps are clearly defined. Organizations often find themselves disappointed when they push too far and expect AI to deliver value in workflows that require creative strategy, highly specific domain judgment, or complex reasoning chains.

"Let agents handle the well-defined, narrow tasks, but with strong human checkpoints," says Papadopoulos. "You don't want open-ended decisions being made by your AI agents yet."

The same need for clear inputs and boundaries applies beyond software. René Bohnsack, Professor of Strategy and Innovation at Católica Lisbon School of Business & Economics, points to a credit-scoring bureau that reworked its processes using AI and can now generate credit scores faster and more accurately by integrating data from across the organization.

THE CHALLENGES OF SCALING AI TRANSFORMATION

The limits become clearer when companies move from focused, well-bounded applications to broad access to generalized AI copilot apps. Despite major investment, these tools often have not delivered the productivity gains leaders expected, according to Bohnsack. Misuse can lead to documents plagued by hallucinations, misaligned solutions that are technically correct but don't solve the problem, and results that require more time to fix than if a human had done it in the first place.

Employees naturally ask these tools to complete tasks they may not be suited for or lack the necessary context to deliver on, and that's where they start failing spectacularly, says Papadopoulos. Context and data are king when it comes to AI, and for copilots and beyond, data remains one of the biggest challenges standing between organizations and successful AI transformation.



Leaders need to connect AI execution to a clear business strategy

Sometimes, the data exists but isn't maintained, clean, or accessible enough for AI models to use effectively. According to Kolk, many organizations mistakenly think they can jump into AI without taking care of the data side of the equation, a misstep that hinders their ability to drive successful AI transformation at scale.

"Many companies have not paid enough attention to data — the way they manage it, data hygiene, governance, integration, and so on. Now with AI, they suddenly expect to be able to run, but they cannot because that underinvestment is coming back to bite them," he says.

Workflows are another significant challenge. To achieve real transformation, they must be fully redesigned around AI, not augmented with it. According to Papadopoulos, that means rethinking roles, decision rights, and core processes. Leaders need to drill into how AI impacts their business at the most fundamental levels, not bolt-on AI and hope for the best, he says.

Companies are also struggling with how to effectively bring the workforce along. AI transformation requires people to completely change how they work, and most people are not too eager to do that, says Kolk. For many workers, performing certain tasks — or performing them in a particular way — has long been part of their professional identity. This is a key adoption challenge, says Kolk, yet he's seen many leaders ignore it. Instead, he suggests they address these resistances head-on with clear communication and sincerity.

WHAT THIS MEANS FOR THE C-SUITE

There are steps leaders can take to overcome these challenges, starting with ensuring all the essential ingredients for AI transformation are in place.

The first step is getting your data in order and recognizing that this isn't just a technical problem. In fact, to a large extent, it's about instilling the right governance, behavior, and accountability, says Kolk.

Next, leaders need to connect AI execution to a clear business strategy, with the governance, skills, and organizational support required to move promising use cases into day-to-day operations. Without that foundation, even technically successful pilots can struggle to scale or deliver measurable impact.

To effectively bring together skills and strategy, leaders must strike the right balance between quick wins they can execute on now and longer-term AI initiatives — and be clear about which use case falls into which category. Recognizing that you may not yet have the data for a specific use case, or that it will require significant workflow changes employees aren't ready for, and either holding off or taking time to prepare, is vital to avoiding pilot purgatory. In the meantime, companies should focus on what they can realistically achieve with AI today, helping them build momentum along the way.

"Think about time to value. How quickly can you move an AI initiative from pilot to deployment, then into something that will have measurable business impact?" says Papadopoulos.

This includes considering AI uses that may be technically narrow but have broad impact. For example, Kolk worked with a company to map the needs of its various business units. Company leaders discovered that despite differences across those units, many needs could be addressed by the same core AI solution with a few tweaks to the front-end user experience. It became an opportunity to make a significant impact while limiting complexity, making it an achievable early win.

"You need to move in steps that are individually valuable, but collectively become transformational," says Kolk.

Leaders are responsible for understanding where true value lies and focusing on substantial business impact, including resisting the temptation to chase shiny use cases that look impressive on paper but fail to move the needle in practice. That means getting smarter about how you track and measure AI impact. According to Papadopoulos, metrics like tokens used or prompts submitted are pointless. He suggests measuring impact (not activity) through metrics tied to efficiency, quality improvements, and economic value.

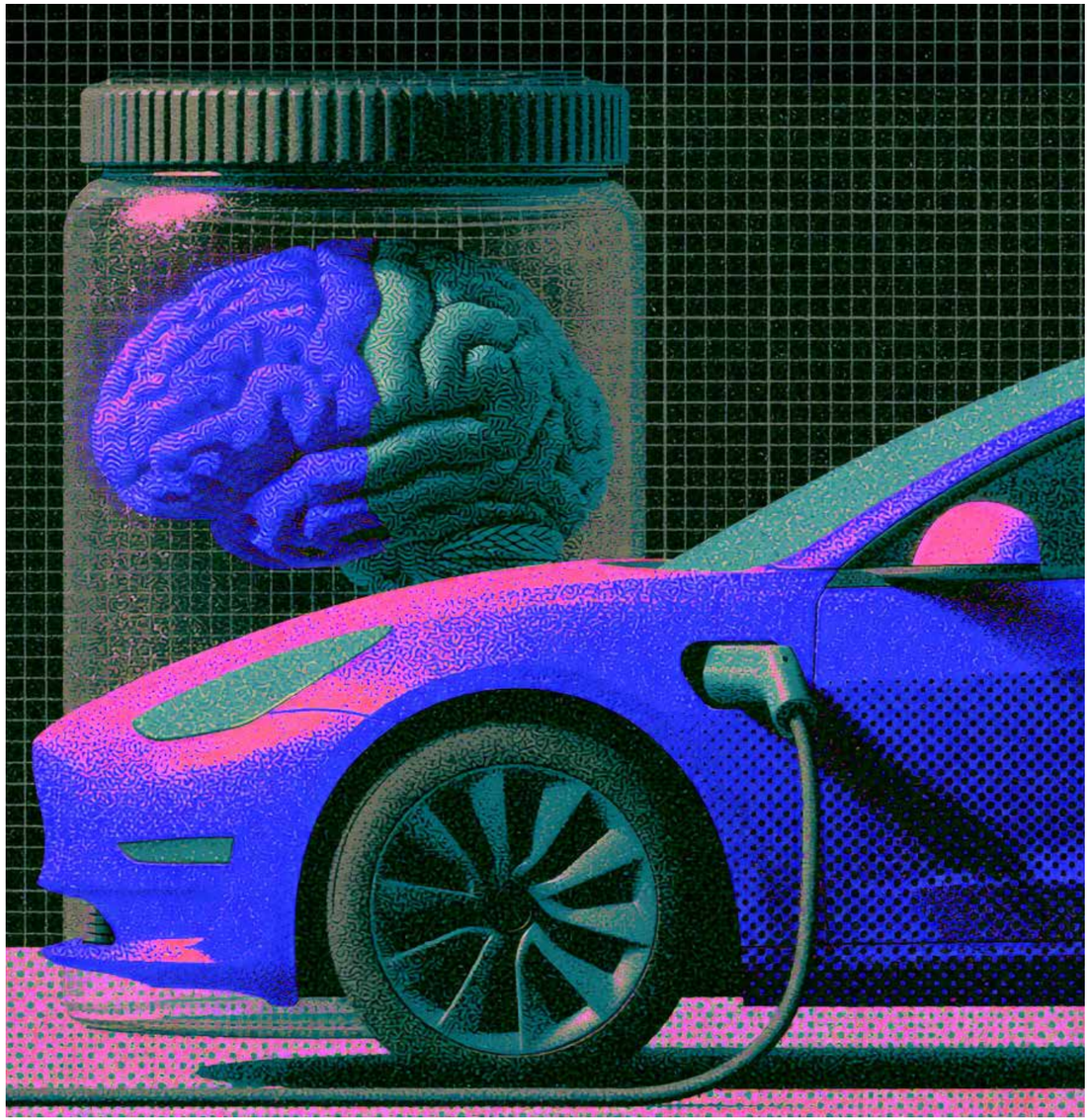
AI may represent a technical leap unlike anything we've ever seen, but the fundamentals of business still hold. Organizations that tie their AI projects to a clear strategy and recognize that this is a business transformation rather than a technical upgrade will be best positioned to reap the benefits.

"The best thing leaders can do right now is focus on strong fundamentals, and those haven't changed in decades," Papadopoulos says. "Clean data, clear use cases, adaptable teams, and strong change management are still essential." ■

Sage Lazzaro is a technology journalist with more than a decade of experience covering how technology shapes society, culture, and work. Her reporting and analysis have appeared in *Fortune*, *The Atlantic*, *Business Insider*, *Wired*, *LeadDev*, *OneZero*, *VentureBeat*, *Supercluster*, and *The New York Observer*. She specializes in emerging technologies, tech ethics, digital culture, and the future of work.

KEY TAKEAWAYS

- **Data fundamentals come first.** Companies can't succeed with AI if their data isn't in order.
- **Balance quick wins with long-term AI initiatives.** This helps leaders avoid getting stuck in pilot purgatory.
- **Focus on solving urgent business problems,** not shiny use cases.
- **Measure AI impact** rather than activity.
- **Remember that AI transformation isn't a technology problem.** It's a people, process, and business challenge.



The global automotive industry is in the midst of the most fundamental change it has ever faced. It's an evolution that's happening under the skin, hidden within the flash memory modules and processors that are gaining in power and importance in every modern car. It's the shift to so-called software-defined vehicles, an inadequate and arguable term that attempts to reflect the increasing role that code plays in shaping the modern driving experience.

Software is not only defining how cars behave but also enabling that behavior to evolve over time. This, in turn, raises consumer expectations, with buyers looking for vehicles that surprise and delight from day one — and continue to impress for years to come.

This revolution in vehicle architecture is coming at a time of unprecedented turbulence in a global marketplace tangled by a dizzying web of regulation. Legacy, deadline-focused software development paradigms and heavily siloed organizations are breaking under the strain, resulting in delays that cost billions of dollars.

To navigate this transition, automotive executives must rethink traditional organizational structures. We spoke with leading industry experts to identify failure points in legacy models and identify better ways forward.

HISTORY & ITS BURDENS

Traditionally, if you wanted to solve a problem in a car with a piece of software, you did it at the source. Controllers for features such as anti-lock brakes or stability control were located where they were needed, performing discrete tasks and nothing more. The teams and suppliers that built them were organized the same way.

"We've been putting software in vehicles since the 1970s, but it's usually been smaller, siloed teams working on very specific functionality within the vehicle," says Sam Abuelsamid, VP of Market Research at Telemetry and former engineer at a Tier-1 automotive supplier.

This created a degree of internal autonomy. "Individual teams could take their module, their actuator, their sensor, and go off into a corner and work in isolation of the broader vehicle," notes Gary Cygan, Director of Platform Engineering at General Motors (GM). The result was an internal corporate structure punctuated by silos, individual fiefdoms of dedicated engineers working on their own tasks. How they got the job done didn't matter. As long as they wrapped things up in time for the deadline, everybody was happy.

That isolation is not without its advantages, but time has shown that it carries some significant disadvantages. One is the burden of supporting countless disparate systems across numerous vehicles. This baggage is increasingly slowing down the older manufacturers and proving a disadvantage in the face of younger competition.

"Some new entrants have the ability to move faster; they don't have the burden from a legacy perspective that some traditional car companies have," says Justin Moon, VP of Core Product Engineering at QNX. "They have no older vehicles, so there is no legacy to worry about."

Add the challenge of providing over-the-air software updates to countless isolated components in a single vehicle, and you can start to see why everything is starting to come together.

ENDING ISOLATION WITH INTEGRATED ENGINEERING

Where once the most tech-forward cars featured dozens or even hundreds of discrete microcontrollers, the trend today is fewer, more powerful components. The modern vehicle is less a collection of disparate systems and more a unified platform running a collection of disparate routines and processes. Jörn Buss, Partner with ADL's Automotive & Manufactured Goods (AMG) practice, says manufacturers have been increasingly asking themselves why their organizations don't match their products.

"Why don't we take a holistic view? Why don't we see this as a truly integrated system and then have a team that really understands all of these things at the same time and programs it from the top down rather than from the bottom up?" said Buss.

This becomes an exercise in coordination and compromise. "Now, as you move software into one central place … these teams have to be coordinated and organized in a very different way," Cygan said. "No longer can the brake team go off and do [its] own thing."

It's a fundamental change for many legacy automakers. "For me to now integrate my teams further basically means I need to more or less dissolve structures that I have been living with for 30, 40, 50 years, and that's where a lot of the struggle comes in," Buss said.

The result is more coordination and communication across teams. Cygan said this requires oversight and, ultimately, responsibility. "You need a centralized structure that is empowered to manage this coordination," he said, someone who can make bigger calls that not everyone is going to love. "Sometimes you make decisions that are beneficial to the platform but detrimental to the specific vehicle."

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For many legacy manufacturers, this is as much a cultural shift as it is an organizational one.

ADJUSTING CULTURE & RISK TOLERANCE

Frank McCleary, Partner with ADL's AMG practice, said that hiring rockstar leadership won't necessarily help. A fundamental culture shift is mandatory.

"We've seen this with OEMs making big splashy announcements of senior hires … and then it slowly fizzles because culturally nothing ever changed. I think fundamentally that's going to be the key," says McCleary.

This doesn't just mean things like casual Fridays or annual team retreats. Buss said that many automakers need to rethink everything, including their risk tolerance. "It's a very big leap, and it exposes legacy manufacturers to enormous risk," he said. "The last thing these legacy players want is more risk because they got burned so many times by being overexposed," he noted.

The problem is that these companies are now competing in a global market being torn apart by upstart brands with a higher tolerance for risk and no burden of legacy systems. Buss calls this "China speed," the ability to develop new cars in as little as 12 months. "We don't know the exact outcome of that; there could be a reckoning moment for some of these newer players, too," he said.

For now, however, traditional manufacturers need to adjust. "You need a thought leader behind that. You need significant risk management behind that. You need a lot of money behind it because you're betting your house," says Buss.

Increasingly, moving too slowly is becoming a risk in and of itself.

NEW RISKS, NEW COSTS

It's an increasingly common and depressing headline: a new model meant to reinvigorate a legacy model's offerings is delayed by weeks, months, or even longer because of software issues. It's happening again and again, and the costs can be extreme. "You're talking anywhere from a few billion to potentially tens of billions of dollars in losses from lost sales," says Abuelsamid.



Many of these delays stem from the organizational challenges discussed above, but those aren't the only landmines faced by modern automotive project managers. "If we keep sourcing to specific requirements instead of looking at the process holistically, we can change engineering all we want, but we'll still be stuck with a procurement cycle that breaks everything apart," says McCleary.

AI has a role in generating the volumes of test data required to put modern driver assistance and autonomy systems through their paces

PLATFORMS, ABSTRACTION & CONTINUOUS INTEGRATION

Avoiding reliance on a single device supplier is critical amid continued supply chain uncertainty, and hardware abstraction layers are becoming increasingly important in that effort. In theory, this software development approach allows the same code to run equally well across multiple comparable chips.

In practice, reliably implementing these lower layers of software support is increasingly difficult and exactly the kind of challenge that has derailed many enterprise software projects over the years. When you layer in the added demands of the automotive sector, including regulations such as the EU Cyber Resilience Act (CRA) and standards like ISO/SAE 21434, which call for transparent update methodologies among other requirements, code complexity can quickly spiral out of control.

This creates opportunities for what are often called "foundational vehicle platforms" — solutions such as Wind River Studio, Elektrobit's EB corbos, and Alloy Kore from QNX and Vector. These platforms take on the daunting task of delivering true hardware independence in a reliable, certifiable way, allowing developers to focus on the features and experiences that actually matter to vehicle buyers.

"We're taking compliance integration off our customers' plates," Moon says. "That lets them redirect resources from work that is essential but nondifferentiating — the kind of work their customers expect but won't pay more for."

This also greatly reduces the testing overhead for these projects, a problem that on its own can quickly get out of hand. "When you start building software, you need to design for testability from the beginning," Cygan said. "You need to build the machine that validates the machine in parallel with the machine itself; otherwise, you'll accumulate enormous technical debt."

This sort of testing — continuous integration — is absolutely vital in enabling the kind of frequent, comprehensive updates that are not only increasingly required by cybersecurity regulations but are also expected by consumers.

Cygan said GM has made "significant investment" in building an architecture capable of reliably running hundreds of thousands of regression tests. "It's absolutely critical to getting to weekly releases, which is our goal," he said.

A task this massive raises another concern: who's going to write all that code?

AI & THE TALENT CRUNCH

The use of a vehicle software platform can greatly reduce the overhead of automotive software development, likewise, reducing the degree of specialized talent required to implement it. Regardless, there's still an overwhelming amount of code to generate.

"I think talent is the biggest and most fundamental problem of legacy OEMs in the Western world," says Buss. This, he said, is largely thanks to talented engineers often choosing to focus on other, more enticing industries in the field of consumer electronics.

To fill that need, a popular approach is retraining current employees, but none of the experts we spoke with were bullish about the results. Abuelsamid said it can be effective for younger engineers. "For those used to working a certain way for 20, 25, 30 years, it's a little more challenging," he said. Buss said these programs often serve a more nefarious purpose: "I think in many cases, especially at Western OEMs, which are often unionized, this is simply a way to avoid firing those employees outright," he said.

Retaining talent is key as well, and McCleary said that many manufacturers continue to rely on a traditional approach: "Throw a lot of money at senior talent and hope that works." But even that has become increasingly difficult in an era when small startups can lure talent with stock options and, in some cases, achieve unicorn valuations. Some manufacturers have tried to respond by launching startups of their own, such as GM's Cruise or Ford and Volkswagen's Argo AI. So far, however, the failure rate of these is high.

To help address their staffing needs, many OEMs are turning to LLMs. But LLMs are not quite the panacea many modern AI startups would have you believe. "AI doesn't turn a mediocre software engineer into an exceptional one, but it can make a really good software engineer that much better," McCleary said.

That said, AI also has a role in generating the volumes of test data required to put modern driver assistance and autonomy systems through their paces. "AI has been useful for generating scenarios by taking data recorded from the vehicle and using it to create synthetic data," Abuelsamid said. "That can mean changing the weather conditions, adjusting the lighting, and creating more scenarios to test against."

AN ECOSYSTEM OF ECOSYSTEMS

The challenges are not unique to any one brand. Across the global automotive industry, many major players have struggled to overcome them, while others remain stuck in the mire.

Moon believes the best solution is collaboration: "I think any one company has gone as far as it can go. Now is the time to start thinking about what it truly means to be an ecosystem of ecosystems." That, he said, is "the next superpower."

But with "great power comes great responsibility," and for legacy automakers, that responsibility starts with preserving what makes them unique. This is, after all, an industry built on brands that coexist precisely because of their disparate ways of doing things.

Disparate ways, though, are not necessarily better ways. "The industry is rife with arrogance," Buss said. "I say that very strongly because every company believes it builds the best possible products, which is partially true and partially not."

Buss believes in admitting they cannot do it alone. By working with newer, younger competitors, manufacturers have a chance of finding success. "For them to make that leap is deeply, deeply respectful because they're admitting they don't have the ability to do it by themselves," he said. "Will it work? I think time will tell." ■

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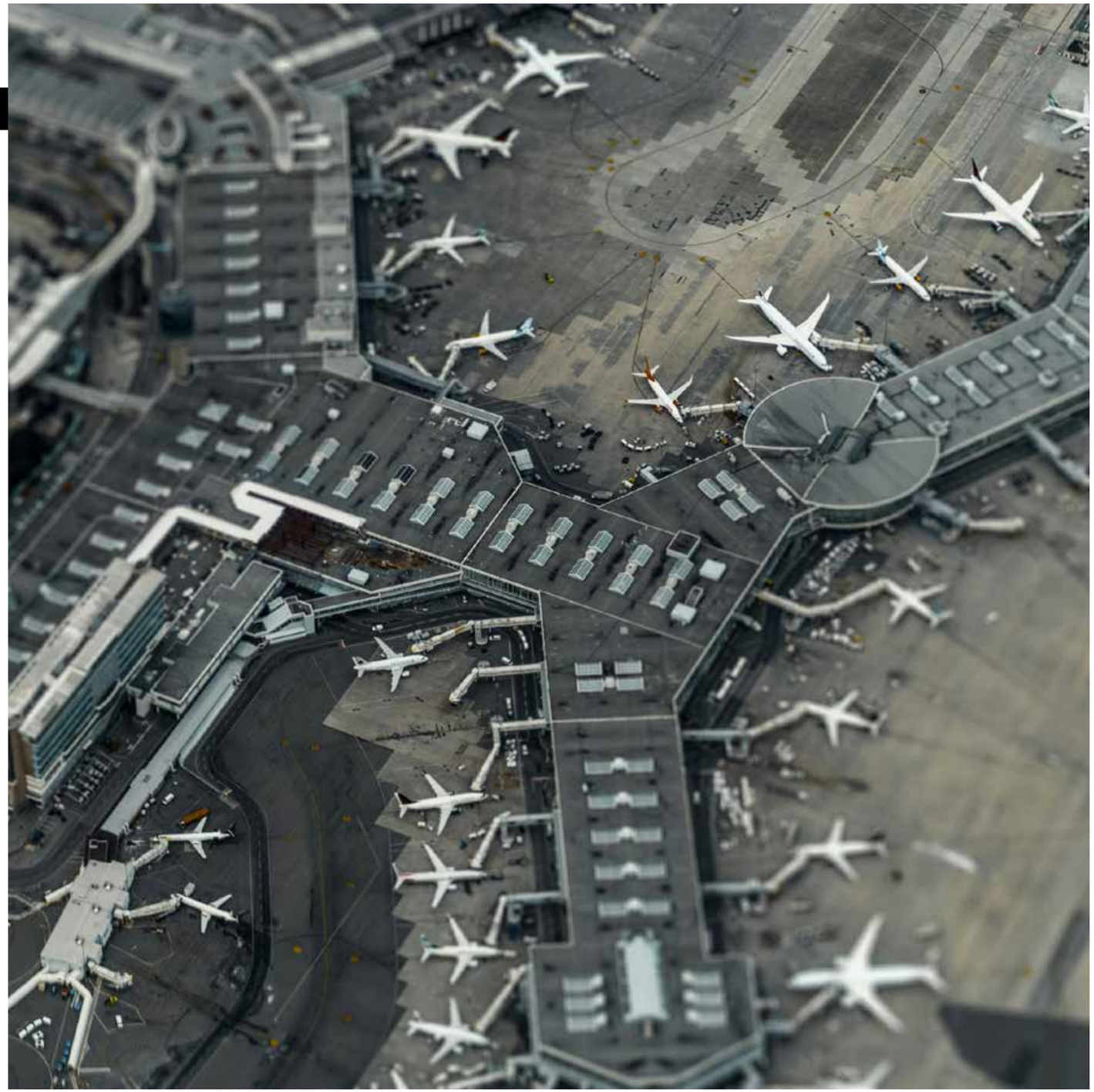
KEY TAKEAWAYS

- **Legacy structure is the primary roadblock.** Transforming to a software-defined model requires dismantling isolated, component-specific silos. Automakers must adopt a centralized, holistic software architecture to succeed.
- **Cultural risk tolerance must increase.** Legacy manufacturers are historically risk-averse, treating software as a safety-critical, single deployment. To compete with newer entrants, incumbents must take calculated risks to reduce development time.
- **Procurement cycles must evolve.** Traditional, fragmented procurement approaches are incompatible with modern, integrated engineering efforts.
- **Foundational platforms reduce technical debt.** Automakers should shift resources away from nondifferentiating code. Utilizing third-party foundational platforms allows automakers to focus on customer-facing features.
- **AI is not a replacement.** LLMs cannot replace experienced engineers. However, AI is effective in testing scenarios.
- **The future of the industry is collaborative.** Overcoming the software transition requires legacy brands to swallow their pride. The most successful automakers will admit their limitations and integrate into an "ecosystem of ecosystems" through strategic partnerships.

AUTOMATION TAKES FLIGHT

Pressures on ground handling are accelerating the move toward autonomous operations — and pushing airport ground handling into a whole new era.

By Paul Marks



Airport labor shortages and ramp-safety risks are moving autonomy from trials to live operation. But the bigger story may be strategic: automation could change how ground handling is staffed, governed, financed, and delivered.

It's a scene frequent flyers often see from their airplane window seats: a tow truck driver parks a train of luggage wagons beside the aircraft. A team of baggage handlers offloads their contents, moving everything from suitcases to musical instruments to skiing gear onto a motorized belt loader that propels them into the aircraft hold.

That familiar, human-populated scene could be set for considerable change in the next few years. This ordinary task has the right elements to make it ripe for technological disruption, according to Alessandro Rosati, Principal with ADL's Travel, Transportation & Hospitality (TTH) practice.

Thanks to industry-wide difficulties in hiring ground-handling crew, Rosati says, the tow trucks circling those wagons (known as "dollies" in airside argot) could become self-driving vehicles. Later, after the technology matures, robots could make their ways to the runway to unload and load baggage.

This type of automation, if it works reliably, could spread widely across the airport industry over the next five to 10 years. Ground support equipment (GSE) providers and airside service operators will be in the vanguard of adopting automated, robotic, and self-driving technologies in baggage and cargo handling. The more mature applications are already being trialed at some major airports, with some moving to deployment, says Rosati.

A raft of airport automation applications will likely follow as technologies mature, he says, including security-screening robots, terminal-cleaning droids, perimeter-inspection drones, driverless pushback tractors for aircraft, and even self-driving passenger buses. Rosati asserts that these systems will "cut costs, help operators cope with labor shortages, increase safety levels across airside operations, and boost on-time departures."

That should allow operators to provide more consistent service because automated systems can help reduce variability in repetitive tasks and support operations when staffing is constrained, says Mathieu Blondel, Partner with ADL's TTH practice and Global Head of its Aviation Competence Center.

This is not to say ousting humans is the overarching aim. "Automation will first take over selected, repetitive tasks that are hard to hire for in areas like baggage handling, but people will remain vital for supervision and handling edge cases, exceptions, and irregular operations," says Rosati.

Structurally, however, Blondel expects adoption of airside and terminal automation to generate profound business impacts. The strategic question is not which robots work, but who can fund, operate, maintain, and govern them at scale.

WHY AIRPORTS ARE TURNING TO AUTOMATION NOW

A mix of factors is driving the airport industry toward this machine-oriented future, led by two societal ones in particular, says Blondel.

"The first shift started during the COVID lockdowns in 2020, when major airports like Amsterdam and Frankfurt asked their subcontractors and ecosystem partners to downsize. But when the air traffic came back, they could not find enough people to reemploy, and since then, they have had a lot of difficulty attracting people to the poorly paid, sometimes physically demanding jobs that are critical to aviation — such as moving baggage in and out of aircraft and passenger security-screening in the terminal."

With high labor costs, aging populations, and safety issues on one side, and robotics technologies getting more mature and efficient on the other, there is a clear case for airside automation

The second shift Blondel cites is demographic: aging populations and falling birth rates are shrinking the working-age population in Europe, Japan, China, and Singapore. The Organisation for Economic Co-operation and Development (OECD) warns that by 2060, it could decline by more than 30% in a quarter of its member countries.

Safety is another driver. In 2024, the International Air Transport Association (IATA) found that 40% of ground damage to aircraft fuselages was caused by collisions with human-controlled airside equipment, including dollies, tugs, cargo loaders, passenger stairs, belt loaders, and boarding bridges. "The introduction of automation could diminish this," says Rosati.

The human cost is high, too. Rosati notes that in 2024, the US government's Bureau of Labor Statistics found that ground operations at airports suffer a level of occupational injuries twice as high as the average in other similar freight-moving industries, such as trucking and warehousing.

"This is not only due to accidents, but to the activity itself: carrying very heavy bags causes many back injuries, for instance," says Rosati.

FIRST WAVE: DRIVERLESS TUGS, AUTONOMOUS DOLLIES & THE VENDOR RACE

With high labor costs, aging populations, and safety issues on one side, and robotics technologies getting more mature and efficient on the other, there is a clear case for airside automation, says Blondel. It's no surprise that major airport hubs in Singapore, the Netherlands, and Switzerland have been among those trialing enabling technologies from autonomous systems vendors.

"Over the last five years, there have been multiple trials across airports globally, where they have been testing fully automated baggage transport dollies," says Rosati. The earliest experiments started with retrofits of existing machines, but more recent pilots involved dedicated autonomous systems.

Why begin with airside baggage delivery and ramp loading? Simple, says Rosati: the tug driver and some of the most repetitive baggage-handling tasks are among the functions that can most easily be considered for automation.

To automate these functions, the tractor that tows baggage dollies (or the trolleys containing cargo bins shaped for in-fuselage stowage) can be made driverless, allowing it to pull dollies that used to work with human-driven diesel or electric tractors.

Several vendors are trialing and, in some cases, deploying advanced driverless airside systems in the automated dolly and cargo tug space. They include Aurrigo (UK), AeroVect (US), and TractEasy, a France-based joint venture marrying the GSE tractor kit of TLD with the driverless technology of autonomous passenger shuttle maker EasyMile.

Aurrigo is fielding its technology in trials at Zurich International Airport and Singapore Changi Airport; AeroVect is doing likewise at Dubai International and San Francisco International. TractEasy is deployed at Istanbul and Frankfurt airports and is in advanced Level 4 driverless tug trials with Japan Airlines (JAL) at Tokyo's Narita International Airport.

That supplier push is being reinforced by operators struggling to keep critical ramp roles staffed. Avports, an airport services provider that runs airside services at 15 US airports, including LAX and Detroit, offers one such demand signal.

"Post-COVID, the ground-handling world lost a huge chunk of its workforce, and it has not fully recovered," says Avports COO Arturo Garcia-Alonso. "Autonomous GSE is not about eliminating jobs; it is about filling positions no one is applying for."

Garcia-Alonso also sees the safety logic behind the vendor push. "Human error is still the leading cause of ramp damage, and the numbers are significant," he says. "The value of sensor-equipped automation is that it can help support more consistent performance in the kind of long-shift, all-weather conditions that make ramp work so demanding."

That does not make automation a replacement for every worker, of course. At Avports, powered wearable exoskeletons are assisting ramp agents with heavy lifting, underscoring the likely mix of automation, augmentation, and human supervision.

SECOND WAVE: ROBOTS IN THE AIRCRAFT HOLD

JAL has been vocal in proposing how the next phase of this automated airside plan might unfold: getting baggage off dollies and into the aircraft hold using robots, not people.

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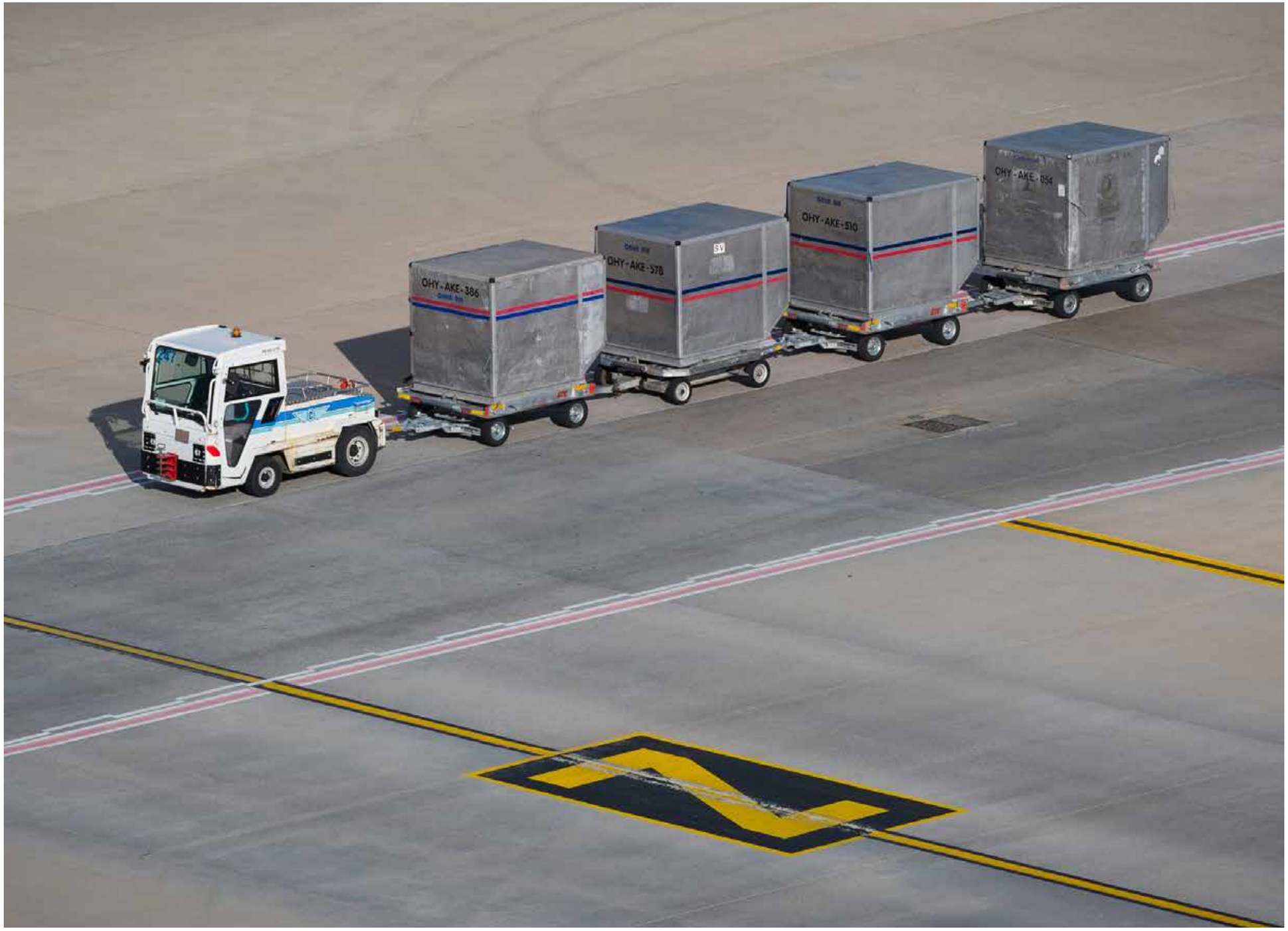

In April 2025, JAL videos attracted attention online when airport executives revealed they would experiment with a sci-fi-like solution: Chinese-made humanoid robots from Unitree and UBTECH that would learn to place baggage and unit load devices in aircraft holds in tests at Tokyo's Haneda Airport, running from May 2025 until 2028. The aim is to see whether humanoids can address JAL's 20% staff shortage on the ramp.

JAL's bipedal droids may look like the stuff of a science fiction movie, but Blondel says that despite the sometimes high degree of human remote control in their operation at the moment, the industry should not be too dismissive of what looks like sci-fi becoming reality.

"It is still very early stages with these humanoids, and sure, they are not yet as capable as humans in many real-world tasks, but everything is improving very quickly in that domain," Blondel says. In China, he notes, many humanoids struggled or failed to finish Beijing's 2025 half marathon, while at the 2026 event, the winning autonomous humanoid completed the course faster than any human runner.

"So, in just one year, they had this huge improvement. When you think about a closed environment like an airport, it could mean capabilities can increase rapidly," he says.

Blondel concedes, however, that a wheeled robot with arms for picking up baggage from dollies and placing them on a belt loader would be, on a flat airport apron, a much more stable option than a legged robot. Such wheeled form factors are much more likely to be deployed at scale before any of JAL's humanoids are ready for primetime.

CASE STUDY: CHANGI'S MAXIMUM AUTOMATION BET

If JAL's plans sound ambitious, consider Singapore Changi, which is building a fifth terminal to increase the airport's passenger capacity by at least 50% — adding capacity for 50 million more passenger movements and bringing the total to 140 million passenger movements per year.

So far, so ambitious. But get this, says Blondel: "Changi does not want to add a single job on the ground to achieve this. It means they need to be super productive or automate. And they have chosen maximum automation."



On its website, Changi confirms this, saying that when T5 opens in the mid-2030s, it will let the airport run with "reduced reliance on manpower" and that its "baggage robots will be tested for operation under rain and lightning conditions at the aircraft stands, to enable continuous operations" in the equatorial island's notorious downpours and storms.

BARRIERS TO ROLLOUT

Despite Changi's bullish automation thrust, the robotic technologies (beyond the driverless tugs already moving into deployment) are immature. "Adoption of automation will be uneven and constrained," says Rosati. "High-repeatability tasks will move first; mixed-traffic, underwing work will take longer."

As autonomous equipment becomes more connected and operationally critical, resilience becomes as important as productivity.

Continuous operations will also require cybersecurity of the highest order as airports move to networks of robots and autonomous systems on the apron and in the terminal, with some machines crossing taxiways and runways. No one in this automated nirvana will want to be in charge of a population of airport robots whose software has been locked up by ransomware.

> **"Preparedness starts with knowing which systems and processes are critical, how they depend on one another, and where the single points of failure are"**

At a time when cyberattacks on aviation systems increased 600% in a single year, from 2024–2025, how should these emerging automated airports pull up the drawbridge and defend themselves?

"Preparedness starts with knowing which systems and processes are critical, how they depend on one another, and where the single points of failure are," says Tom Teixeira, Partner in ADL's Performance practice. "Organizations then need to test realistic cyberattack scenarios against those risks."

Teixeira says aviation's CISOs must put senior management under pressure to make effective decisions when deficiencies are detected, so they are addressed in technology upgrades and improved business continuity planning.

AI adds another layer of risk: models and the physical systems they power, including robots, can be attacked in new ways. That concern prompted the US Federal Aviation Administration's (FAA's) Airport Cooperative Research Program (ACRP) to hold a May 2025 workshop on AI's benefits and risks for airports.

STRATEGIC IMPLICATIONS: FROM AUTOMATION PROJECTS TO OPERATING MODEL DECISIONS

Airside automation is not one technology story but a sequence. Driverless baggage tugs and autonomous dollies will likely scale first because they address repeatable, high-pain-point tasks. More complex underwing work, including robotic baggage loading inside aircraft holds, will take longer because it requires tighter integration with people, aircraft, weather conditions, safety rules, and irregular operations.

That means aviation executives should treat automation as an operating model redesign, not a procurement exercise. Airports, ground handlers, and GSE providers need to decide not only which technologies to deploy but also how those technologies will be supervised, maintained, integrated into daily operations, governed for safety, protected from cyber risk, and supported by the workforce.

For ground handlers, the key question is scale. Operators that can standardize processes across stations, train supervisors, and integrate autonomous equipment into irregular operations will be better positioned than those that treat robots as isolated assets. The winners will be those that can turn automation from a pilot project into a repeatable operating capability.

That operating shift also has an economic consequence. As automation moves from trials to deployment, parts of ground handling begin to shift away from a purely labor-intensive OPEX model and toward a more capital-intensive model requiring up-front investment in equipment, software, integration, maintenance, and lifecycle support. Blondel notes that this could favor larger players with stronger balance sheets and potentially accelerate consolidation because they can fund equipment, absorb implementation risk, and use lower unit costs to win market share.

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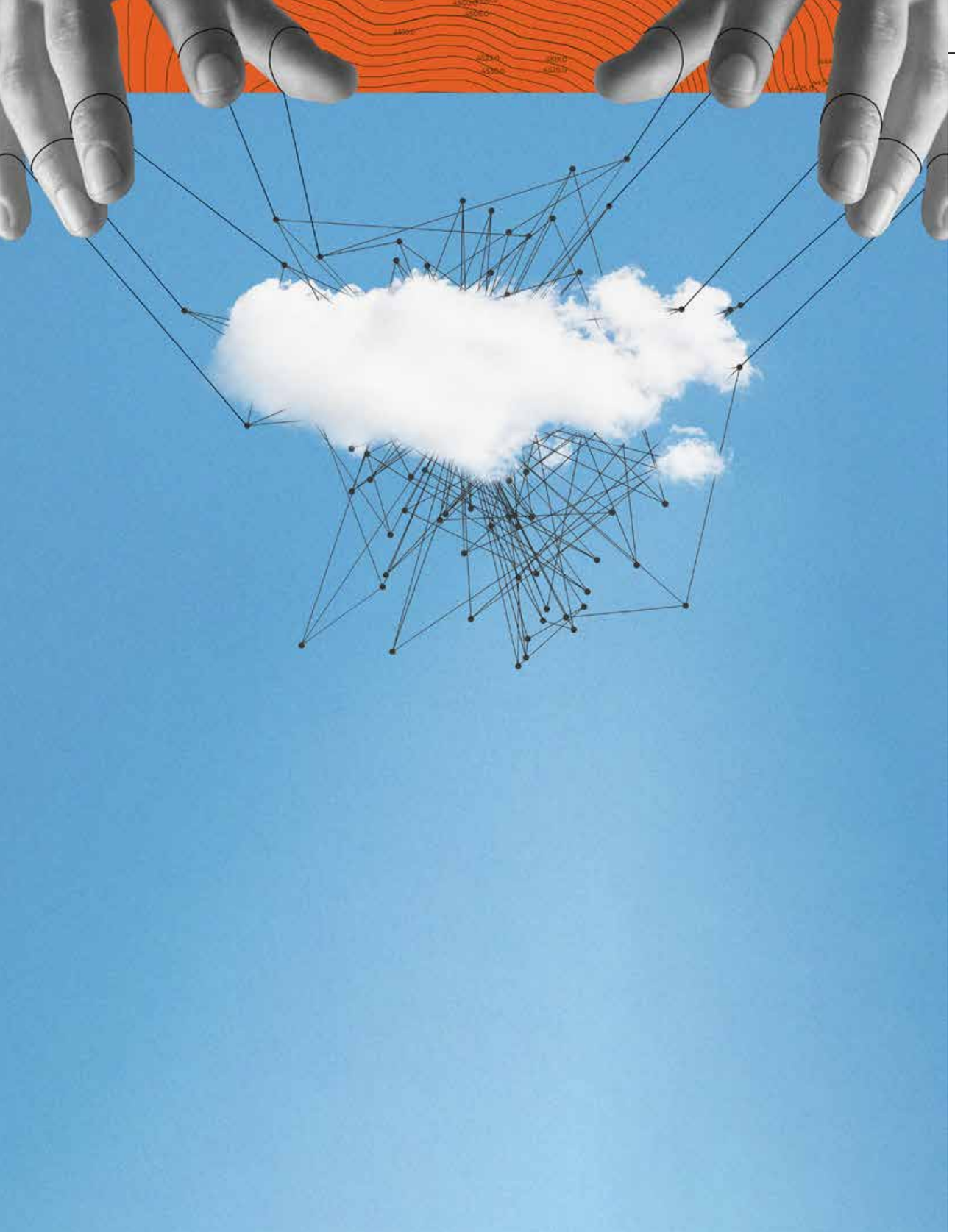
For OEMs and technology vendors, that CAPEX burden creates an opportunity to rethink the commercial model. Instead of relying only on one-off equipment sales, vendors may increasingly offer leasing, maintenance, software support, upgrades, and uptime guarantees. Managed service models could make automation more attractive to customers who want the productivity benefits without carrying the full up-front investment themselves.

Airports will also need to pay close attention. If automation makes ground handling look more like infrastructure — capital-heavy, standardized, safety-critical, and tightly integrated with airport operations — some airport operators may see a case for taking a more active role in the ecosystem, whether through partnerships, operating standards, shared platforms, or, in some cases, direct participation.

From a strategy standpoint, this is about more than robots cutting costs. Automation could redraw parts of the airside value chain. The likely winners will be those that connect technology deployment to workforce strategy, safety performance, cybersecurity resilience, operational standardization, and a clear economic model. ■

KEY TAKEAWAYS

- **Airport automation** is being driven by labor shortages, demographic constraints, ramp-safety risks, and the need for more reliable service.
- **The near-term opportunity** is in repeatable use cases such as driverless baggage tugs and autonomous dollies.
- **The technologies that scale first** will be those that solve staffing, safety, and reliability problems in day-to-day operations.
- **Cybersecurity, safety governance, and human supervision** must be designed into autonomous airside systems from the outset.
- **Strategically, automation should be treated as an operating model redesign**, not a one-off equipment purchase.
- **Over time, CAPEX-heavy automation** could favor scaled ground handlers, create OEM leasing or managed service models, and give airports reasons to take a more active role in the ground-handling ecosystem.



CLOUD CONTROL

RETHINKING DIGITAL DEPENDENCE IN THE AGE OF AI

As cloud and AI infrastructure concentrates, businesses face growing sovereignty, resilience, and continuity risks — forcing leaders to rethink control of their most critical digital assets.

By Jennifer Baker

In late September 2025, Microsoft disabled a set of Azure and AI services used by a unit of the Israeli Army reportedly linked to military intelligence and alleged to have conducted mass surveillance on Palestinian citizens. In a separate incident, following US sanctions on the International Criminal Court (ICC) in The Hague, Microsoft blocked the email account of ICC's chief prosecutor. ICC has since dropped Microsoft in favor of a German open source alternative. These examples are part of a broader trend in which US-based IT infrastructure services have been withdrawn or restricted due to government sanctions and executive orders.

Regardless of one's political perspective, it's clear that global information and communications systems are heavily reliant on cloud services provided by US-based tech giants Microsoft, AWS, and Google Cloud. Together, these three providers account for approximately 63% of the global cloud infrastructure market, according to recent estimates. Like any other company, they are subject to the laws and policies of their home country. As Michael Majster, Partner in ADL's Innovation practice, puts it, "Obviously, there is some kind of US sovereignty on most of the hyperscalers our data sits on." (For context on sovereignty and control, see PRISM article "Technology & AI.")

In today's fractious and uncertain geopolitical climate, digital dependence on third-party providers is emerging as a critical concern. The world's growing reliance on AI adds another layer of risk: not only is AI predominantly delivered through the same few cloud providers, but it also relies on a highly concentrated supply chain — spanning chip design (Nvidia, US), lithography (ASML, Europe), and fabrication (TSMC, Taiwan). Businesses today are urgently reviewing their digital dependencies.

How can businesses ensure continuity, avoid reputational damage, and maintain competitiveness when critical digital assets are this exposed to third parties over whom they have no control? Is bringing digital infrastructure in-house always the best option? (ADL's recent Viewpoint "Tech Strategies for 2026" provides a post-VUCA playbook focused on productivity, efficiency, and resilience.)

HOW DID WE GET HERE?

The migration of digital assets to the cloud has been underway for several decades, beginning with applications like email and customer relationship management. Next came the adoption of cloud-based test-and-development environments offered by providers like AWS, Azure, and Google Cloud Platform (GCP), and around 15 years ago, by customer-facing services (e.g., websites and e-commerce platforms).

Over the past decade, enterprise software as a service has expanded significantly to include core systems such as finance and procurement, as well as foundational elements like databases and data lakes. Software began being offered on a cloud-first and (increasingly) a cloud-only basis. The benefits of cloud-based digital systems are well established: reduced capital investment, lower maintenance requirements, increased flexibility, enhanced resilience, built-in redundancy, and strengthened security.

However, over the last five years, the "everything to the cloud" philosophy started to shift, driven initially by highly regulated domains with sensitive data — defense, critical infrastructure, and healthcare, for example. New data sovereignty rules, such as GDPR (General Data Protection Regulation) in Europe, began acting as a constraint. Low-latency applications, such as industrial control systems, are also less suitable for cloud migration.

This led to the first hybrid cloud solutions with critical systems on premise and others remaining in the cloud (see ADL Viewpoint "Open Digital Architecture: The Next Frontier for Resilience" for an example architecture pattern). Cloud providers started offering tech solutions in customers' own data centers (e.g., Azure Stack, AWS Outposts, and Google Distributed Cloud). As Majster notes, "Digital capabilities have become increasingly core to the intrinsic value of a business, but outsourcing the whole thing has become less and less attractive."

Nevertheless, most large enterprise users, especially those not in highly regulated or sensitive sectors, are still cloud-dependent.

IMPROVING DIGITAL ASSET CONTROL

The first step in strengthening control of digital assets is assessing the tech stack (infrastructure, platforms, and applications/data) and deciding which workloads are most critical in terms of business continuity and competitive advantage — and where they reside.

Repatriating everything on premise is virtually impossible. For example, in most organizations, it doesn't make sense to replace basic cloud services like Teams, OneDrive, and Windows or enterprise system platforms like Salesforce. Identifying high-criticality workloads that must remain under direct control, low-criticality workloads that can reside in the public cloud, and those in between that may be suited to a hybrid approach, is relatively straightforward.

Ideally, infrastructure should be brought into sovereign jurisdiction. A modular approach can be adopted for on-premise compute for critical workloads. Establishing hybrid architectures can ensure that critical systems are not fully dependent on one provider. Proprietary cloud-dependent services can be replaced with open source equivalents where justified.

Data is one of the biggest risk areas, and maintaining control of sensitive data within the enterprise is key. This may require updated data management policies and the implementation of advanced encryption systems. Just as important is a thorough review of the commercial and legal implications of reducing cloud reliance — including exit clauses and contractual limitations on what external providers have permission to do.

Organizations seeking a more comprehensive solution can set up a sovereign factory. This is a secure, enterprise-controlled

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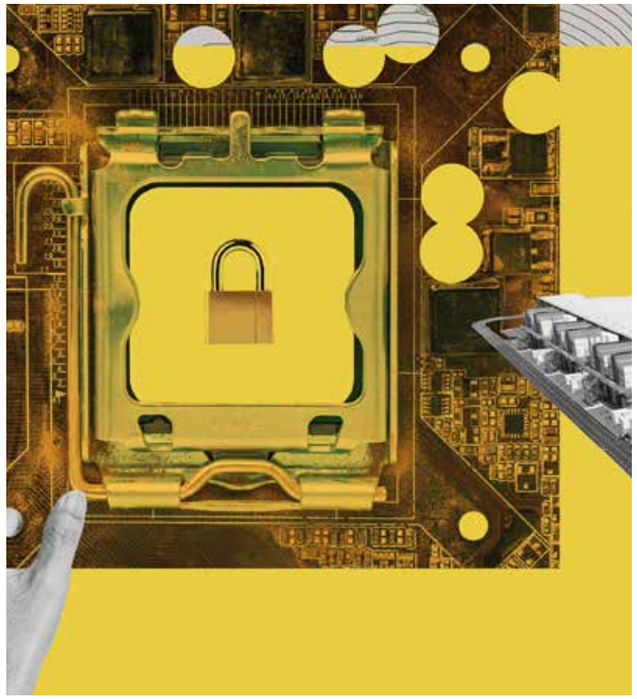
In today's fractious and uncertain geopolitical climate, digital dependence on third-party providers is emerging as a critical concern



environment for developing and operating digital assets outside the jurisdiction of foreign-based providers and US hyperscalers. However, if developed in-house, this type of solution tends to be expensive and time-consuming, and it usually requires several new skills. Most businesses following this route are large enterprises in sensitive sectors, such as defense, finance, and energy.

Some companies are partnering to share the burden of establishing a sovereign factory. "We see more and more initiatives by critical infrastructure companies like energy transmission operators, railway networks, and airports setting up a sovereign factory jointly for critical processes. Not only does this distribute costs and risks, but it also provides an excellent platform for data sharing and co-innovation," says Majster.

However, providers such as OVHcloud, Orange/Capgemini Bleu, and Deutsche Telekom are now offering sovereign factory as a service — external third-party solutions that deliver strict sovereignty guarantees under local or national jurisdiction. Hybrid solutions are also emerging.

Of course, ensuring your digital assets remain under the sovereignty of your home country isn't always a good thing. "In many nondemocratic countries, companies and private individuals are putting their data outside the country because they don't trust the government," explains Karim Taga, Managing Partner and Global Head of Functional Practices at ADL.

Owning digital and AI capabilities creates intrinsic value for a business

WHAT ABOUT AI?

Once integrated and scaled, AI becomes embedded across the entire technology stack. It relies on underlying infrastructure, platforms, and data, and is increasingly integrated into applications, processes, and operations. AI also introduces a parallel substack — comprising the AI platform, AI-specific data, and the deployed models.

As a result, the risks inherent in each layer of the technology stack apply equally to AI, with additional risks stemming from dependencies on hyperscalers and external AI solution providers. Moreover, as AI — and particularly agentic AI — scales within the enterprise, it becomes increasingly critical to business continuity.

AI warrants particular attention in the context of digital sovereignty. In essence, enterprises must adopt the right operating architecture to suit the criticality of the AI workload: on-premise sovereign factories where data is highly sensitive, third-party sovereign platforms where local data residency and compliance are needed, and public AI platforms for generic and less sensitive data. (The recent ADL Blue Shift report "AI's Hidden Dependencies" explores this in-depth.)

Building an on-premise AI sovereign factory may seem like a tall order for a medium-sized or smaller company. Fortunately, the task is getting easier. "Even if you're a small company, the world has changed. For example, companies like Mistral are offering a full AI suite that operates on three GPUs," says Taga. A tier of specialist GPU clouds, including CoreWeave, Lambda, Crusoe, Scaleway, and Nebius, has emerged, offering localized or sovereign compute options outside hyperscaler control.

Many companies today feel the need to develop and deploy as many AI use cases as possible. But experts caution that relying solely on widely available, off-the-shelf AI applications is unlikely to deliver sustained competitive advantage. Over time, these tools will become as ubiquitous — and as undifferentiating — as Excel or Windows.

Innovation-focused businesses are already looking at more bespoke and specialized small language AI models with proprietary datasets that better meet their needs. There is little doubt that if an AI model is designed to analyze molecular configurations for chemical development, it does not also need to generate dinner recipes. As Taga says, "Using AI as a foundational technology to create something unique and differentiating, or producing a new small language model to help your client or yourself, gives you competitive advantage." Owning digital and AI capabilities creates intrinsic value for a business, and there are already good examples of in-house datasets and digital capabilities being deployed to generate new income streams.

Given the pace of technological advancement and today's uncertain geopolitical climate, businesses should consider advancing their data and AI sovereignty position sooner rather than later. ■

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KEY TAKEAWAYS

- **Assess the criticality of workloads** across the tech stack and their dependencies on third parties.
- **Improve control of critical digital assets**, including infrastructure, on-premise compute, and the AI substack.
- **Establish hybrid architectures** to ensure critical systems are not fully dependent on one provider.
- **Replace cloud-dependent services** with open source equivalents where justified.
- **Consider partnering** to share the costs and risks of developing sovereign factories.
- **Move away from reliance on public AI models** to build competitive advantage.

THE GREAT UNLEARNING

YESTERDAY'S THINKING CAN'T STEER TOMORROW'S STRATEGY

By Sally Percy

Deep uncertainty demands something beyond traditional strategy. ADL's FOE framework helps leaders unlearn legacy thinking and build resilience in a fractured, overloaded, and entrenched world.

Today's leaders are operating in an era of elevated uncertainty. In fact, uncertainty has arguably reached its highest level since the Cuban Missile Crisis of 1962, when the world briefly teetered on the brink of nuclear war.

Intensifying geopolitical rivalries, particularly between the US and China, are impacting strategies and supply chains as countries and companies look to align themselves with jurisdictions perceived as "friendly." Meanwhile, the war in Ukraine and concerns over Russia's future territorial ambitions are driving European countries to increase spending on defense (see PRISM article "Tariffs, Geopolitics, and Supply Chains").

And it is not just the threat of a major conflict fueling uncertainty, either. A broader sense of unease is being driven by several key developments: sweeping changes to the US tariff regime, which are reshaping the global trade landscape; the growing momentum of populist political movements in many countries; soaring levels of sovereign debt, which are stifling economic growth and increasing the risk of financial crisis; and the ongoing shift toward a more sustainable economy.

Simultaneously, the rise of AI is creating technology-related uncertainty. On one hand, it looks like the world is about to be transformed by AI technologies, with widespread implications for how we live, work, and communicate. On the other, markets are fearful that companies may not generate adequate returns from their vast AI investments, with AI seen as a bubble on the verge of bursting.

In light of all this, few would deny that leaders are navigating a volatile, uncertain, complex, and ambiguous (VUCA) world. What's more, as ADL Chairman and CEO Ignacio García Alves highlights, they must navigate this VUCA world while balancing two "ambidextrous" priorities. "Leaders must deliver today and build for tomorrow, while continuously adapting to accelerating VUCA events," he says.

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CHALLENGING TIMES

"VUCA" was first coined nearly 40 years ago by the US Army War College to define the challenges of operating in the post-Cold War world. Although it remains relevant in today's business landscape, the concept has limitations and, on its own, is not a sufficient framework for strategizing in the near term or beyond.

"We're not just working in a volatile, uncertain, complex, and ambiguous world," explains Sally Menassa, Partner in ADL's Growth practice. "We are also working in a much more intricate world."

A key limitation of the VUCA framework is that it predates the era of digital disruption — an era that has accelerated significantly with the rise of AI technologies, particularly since the launch of ChatGPT in 2022. "AI is a big uncertainty, and it's not yet clear which organizations it will affect and in which ways," says Michael Kolk, Global Practice Leader of Innovation at ADL. "What's happening in AI now is complex and will affect many business processes" (see ADL report "Moving Innovation Forward").

VUCA neither addresses the root causes of uncertainty nor offers strategic responses to it. What's more, it has major blind spots (e.g., overlooking the convergence of global crises), and it fragments reality into four components that are actually tightly entangled and interdependent. Uncertainty largely results from complexity, for instance. For these reasons, García Alves cautions that VUCA is just one tool for viewing today's challenges. "There are many lenses you can use, and VUCA is one of them," he says. "But you might not see everything through VUCA. You also need to look at other frameworks."

CONVERGING DISRUPTIONS

The interconnected nature of today's uncertainties underscores the need to examine them through multiple lenses. "Today, we're not just talking about separate disruptions," argues Menassa. "We are also talking about how these disruptions converge and amplify each other. The sustainability crisis, geopolitical fragmentation, and competition for resources are all making it harder for leaders to manage volatility the way they used to."

Business models must shift in response to the speed of change, as well as the interconnected nature of disruptions, Menassa believes. "Past operating models were built around predictability and efficiency, which made sense because the world was much slower," she says. "Now, the premium is on how fast you can adapt. To win, organizations must shift from a static operating model to an adaptive one. They need to learn how to configure, reconfigure, and pivot" (see ADL Viewpoint "Developing Resilience for Global Supply Chains in Crisis").

Some of today's most successful organizations already prioritize rapid learning and sensing mechanisms that can be quickly reconfigured. For example, to improve its vehicles, Tesla proactively seeks customer feedback on defects. Netflix continually experiments, using A/B testing to inform product decisions. Microsoft has consciously shifted from a "know it all" culture to a "learn it all" one. (For a practical blueprint to make sensing measurable and reconfigurable, see ADL Viewpoint "Resilience Through Transparency.")

Menassa, based in the Middle East, sees the principle of "learning through uncertainty" play out firsthand. New cities, such as The Line in Saudi Arabia, are being developed amid constantly shifting financial, regulatory, and technological landscapes. "I hear my clients say, 'Let's build the plane while we're flying it,'" she notes.

Kolk also believes that new ways of thinking and operating are critical to success. "With innovation, for example, the traditional way of thinking is 'We invest in R&D and other types of innovation to protect our current business and expand it,'" he says. "The strategy is to produce a new product or an improved product, but what if we instead focused on generating data that is worth more than the product itself?"

According to Kolk, new ways of thinking can mean being open to different options. They can also mean thinking critically, especially given the rise of AI, which is renowned for hallucinating (presenting false information as fact). "Critical thinking will become one of the most important traits an individual or an organization can have," he says. "AI will answer a question, but you need to be able to see the difference between an excellent answer and a good answer and between a good answer and a lousy answer."

VUCA neither addresses the root causes of uncertainty nor offers strategic responses to it

“FOE is based on systemic analysis to help leaders better understand the nature of current uncertainties and how to respond strategically”

A MODERN PLAYBOOK

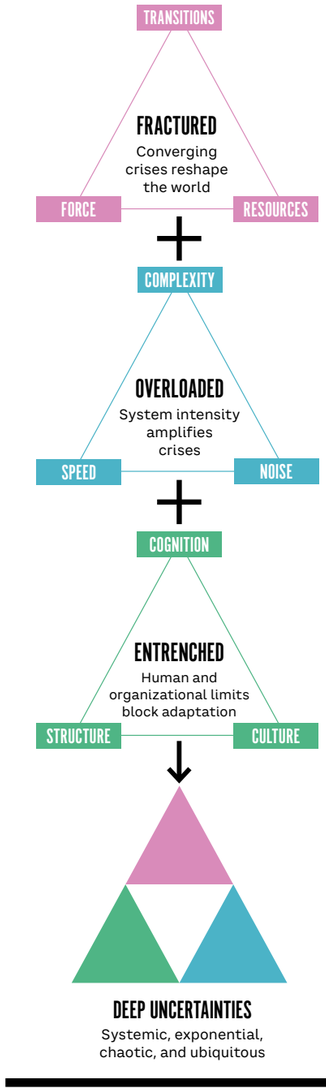
To help leaders think and respond differently to today’s uncertain world, ADL has developed its own framework: FOE (fractured, overloaded, entrenched). Designed to complement VUCA and other established models, FOE serves as the foundation of a broader methodology — currently in development — for navigating uncertainty.

The FOE framework aims to address the main limitations of VUCA, account for underlying trends and the factors that amplify them, consider organizational and individual constraints, and better explain the deep uncertainties that govern today’s world. Examples of these uncertainties include the impact of global warming on the physical, political, and regulatory environment and the implications of AI-powered disruption for our global economy and society (for the infrastructural and resource constraints behind this, see ADL Blue Shift report “AI’s Hidden Dependencies”).

“A big challenge for leaders today is how to strategize in the context of deep uncertainty,” explains Albert Meige, Director of Blue Shift, ADL’s forward-looking institute. “FOE is based



THE ADL FOE FRAMEWORK



FOE stands out because it encourages leaders to consider people-related factors when strategizing for the future

on systemic analysis to help leaders better understand the nature of current uncertainties and how to respond strategically."

FOE is grounded in the logic that the visible events that create business risk, such as heatwaves and cyberattacks, reflect deeper trends like global warming and digital transformation. In turn, those trends stem from structures (e.g., an energy system based on fossil fuels and a globalized economy) enabled by technological systems. And these structures rest on mental models: a belief in infinite growth and in technology's ability to solve all problems (see ADL Viewpoint "The Predictive Resilience Imperative"). FOE enables strategic decision-making by describing a world that is:

1. FRACTURED

The world is being ruptured by the convergence of three sets of exogenous crises: crises relating to planetary, technological, and geopolitical transitions; crises over resources such as energy, water, and critical materials; and crises of force as power reemerges as a major mode of regulation. Notably, crises relating to transitions, resources, and force tend to intersect and reinforce each other. For example, countries are competing fiercely for rare earths that are essential for modern technologies, national defense strategies, and the green energy transition.

2. OVERLOADED

Organizations are increasingly overwhelmed by complexity, speed, and noise — factors that amplify crises of transition, resource scarcity, and geopolitical tension. The complexity of blurred sector boundaries, accelerating technological convergence, and a highly interconnected global economy all intensify pressure. Then there's the speed of systems, fueled by technological, financial, and informational infrastructures designed to respond rapidly; yet, this acceleration is outpacing the adaptive capacity of both organizations and individuals while also increasing the rate at which crises unfold. Noise, stemming from a world saturated with both information and misinformation, rounds out the overload. Algorithms amplify both, and certain political, economic, and ideological actors actively weaponize them.

3. ENTRENCHED

Companies' capacity to adapt to change is blocked by three internal barriers: cognitive biases of their own people, inflexible command-and-control organizational structures built for stability rather than adaptation, and cultural resistance to change.

WHY WE NEED FOE

The combination of the three FOE components creates the deep uncertainties that exist today. By understanding each of them, and developing a strategic response, leaders can enhance their organization's clarity of purpose, strategic agility, and collective resilience. This way, when the environment moves around them — as it invariably will — their organizations will be able to stay grounded, sense and adapt, and effectively recover from shocks (see ADL Viewpoint "Preparing for the Unpredictable").

For Meige, what sets FOE apart from VUCA is that it offers guidelines for navigating deep uncertainty. "For companies and decision makers, the temptation is to see uncertainties only through the lens of events because they are the visible tip of the iceberg, the easiest to grasp," he says. "Yet these events sit within broader trends that in turn arise from structures and infrastructures shaped by dominant mental models."

"VUCA is useful, and it will always be useful," Menassa states. "But it is not necessarily sufficient because VUCA and other traditional frameworks were designed for a world that is more stable than the one we have today. They assume that you can forecast and plan, and that if you forecast and plan, you are going to be successful. But given the disruption and discontinuity we have now, we need a framework that is built differently. Instead of just predicting and planning, we need to be continuously sensing and adapting."

García Alves believes that FOE stands out because it encourages leaders to consider people-related factors when strategizing for the future. "Previous frameworks tended to overlook the human dimension, which is how humans relate to what is happening," he says. "That's what differentiates our framework. All the change in the world is creating a lot of anxiety. People feel that they are not controlling their future, and they want to take back control."

WE MUST UNLEARN

In today's fractured, overloaded, and entrenched world, companies that cling to traditional frameworks and "best practices" risk obsolescence. "Resistance to cultural change has always been an issue," Menassa says. "And resistance usually stems from having been successful in the past. Companies overvalue what made them great, but undervalue emergent ideas they don't necessarily understand, which could make them less relevant. Unless we can shift mindsets, transformation is not likely to succeed. We need to unlearn to move forward."

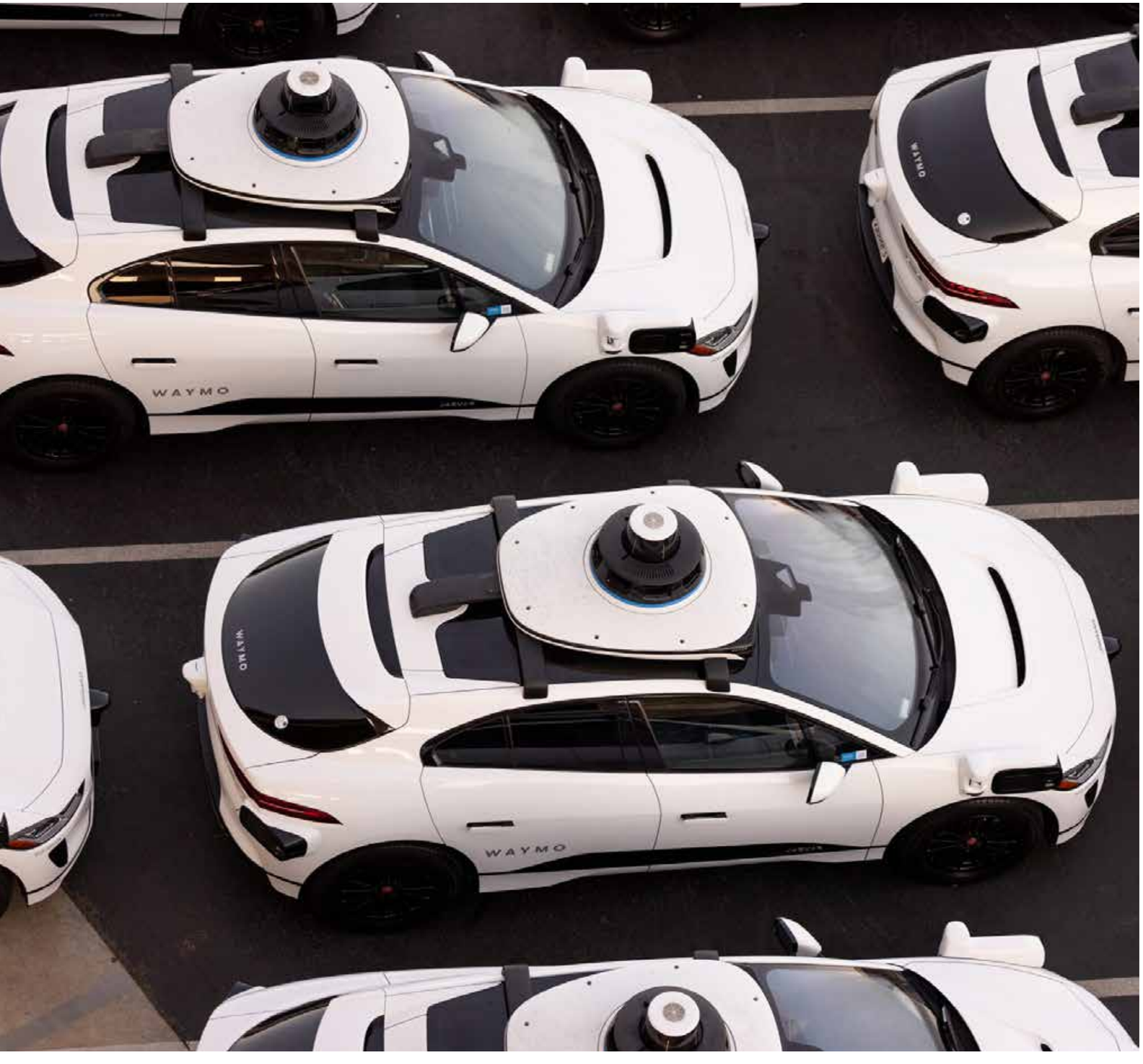
According to Kolk, future organizations must become more adept at gathering and interpreting intelligence. They also need to make stronger decisions in increasingly complex internal and external environments — considering a broader range of options, perspectives, and disciplines. He believes the most successful organizations will be those that move away from "almost always" favoring the status quo. "The cost of doing nothing is going up," Kolk says. "Chances are, your organization is going to be disrupted or made uncompetitive in the future, so just staying put will not work."

"We need to start loving uncertainty," concludes García Alves. "That's the ultimate destination." ■

Sally Percy is a business journalist and editor specializing in leadership and management. A leadership contributor to *Forbes*, she has also been published in *The Telegraph*, *Management Today*, *Elite Business*, and *Accounting and Business*. She is the author of three books: *The Disruptors*, *21st Century Business Icons*, and *Reach the Top in Finance*.

KEY TAKEAWAYS

- **Don't just look at uncertainty through one lens**. Use multiple lenses to highlight a variety of issues and gain diverse perspectives.
- **Consider how the disruptions facing your organization converge and amplify each other**. Adjust your business model accordingly.
- **Integrate the concepts of fractured, overloaded, and entrenched into your strategic thinking**. Use them as guidelines to inform future planning.
- **Challenge the status quo** by learning and sensing, being open to new ideas, and disrupting your business model before it's disrupted for you.
- **Have a positive mindset about uncertainty** — see it as an opportunity, not just a threat.



STUCK IN TRAFFIC

HOW TO GET THE URBAN MOBILITY DREAM MOVING

By John Surico

Technology may be key to realizing virtuous mobility in our cities, but it will only work if the key building blocks — vision, supply-demand management, and funding — are in place.

It's a future for our cities where the car is no longer essential. The metro, bus, or train — all just a tap away. Bikes, scooters, and other micromobility vehicles are docked nearby and ready to use. And yes, self-driving cars, always around if you need a lift.

For years, a growing chorus in the mobility and tech sectors has envisioned a future where private car ownership is obsolete and traffic a relic of the past. This future promised to ease the burdens of cost and congestion by giving individuals more control — enabled by an all-in-one integrated platform, or mobility-as-a-service (MaaS), where every travel option in a city is accessible at your fingertips. At the same time, autonomous vehicles (AVs) were gaining momentum. The COVID-19 pandemic, which disrupted daily routines, amplified calls for more personalized, flexible mobility solutions.

But this urban mobility dream is still exactly that: a dream. Although MaaS exists in various forms worldwide today, our transport landscape remains siloed. AVs work, but proper governance mechanisms are still being beta-tested. And as debates rage on, car trips have only increased in the pandemic's wake — people are driving more, not less.

Put simply, this wasn't the future we were promised. At least not yet. Much has been written about why this hasn't happened and how it could still happen. But is the urban mobility dream actually possible? And if so, what would be needed to revive it?

Although MaaS exists in various forms worldwide today, our transport landscape remains siloed

FITTING AVS INTO FRAMEWORKS

In a growing list of countries, self-driving cars and shuttles are becoming a familiar sight. In San Francisco, AVs line up outside concerts. In Shenzhen, robotaxis are just a tap away. London is set to launch a similar service in 2026. The technology, while still working out some kinks, is getting there (see ADL's "Autonomous Mobility Journal").

While the technology continues to advance, its success won't hinge on sensors and software alone. "The question of adoption is less of an issue now," said François-Joseph Van Audenhove, Managing Partner at ADL and Head of its Future of Mobility Lab. "I believe people will accept it; the trust [builds] relatively quickly. Now the real question is how to properly frame and enable these services to ensure they are well-integrated within our mobility systems."

Two scenarios have since emerged, notes Van Audenhove. In the first — seen in the US and China — AVs replace traditional taxi and delivery services: self-driving robotaxis take over ride-hailing, and AVs deliver food and parcels directly to your doorstep. The second, more common in Europe, positions AVs as a complement to mass transit — offering first- and last-mile connections to subway or train stations, circulating around airports, or operating during off-hours and construction periods (see ADL Viewpoint "DRT: A Key Lever to Bridge Mobility Gaps").

Both models have produced mixed results — in part, Van Audenhove says, because cities have yet to answer a fundamental question: "What will be the value of the self-driving car?" EVs face a similar quandary: while they reduce carbon emissions, increased driving, enabled by the perception of cleaner energy, could worsen congestion. And if the energy grid isn't fully decarbonized, emissions may still rise. For AVs to deliver on their promise, cities must define clear policy objectives (e.g., reduced vehicle miles traveled) and establish measurable pathways to achieve them (e.g., setting a target for the percentage of trips taken by AVs by 2030).

If automation is nigh, then municipalities must fit this technology into a future that provides tangible benefits to everyone. "A virtuous mobility system is like a house," Van Audenhove explains. "It first needs to be guided by vision, policies, and governance (the roof). The floors are the supply (the different mobility services offered) and demand (influencing mobility behaviors), which need to be actively managed. These need to be supported by adequate funding, acting as the foundations of the house" (see ADL report "The Future of Mobility 5.0").

Van Audenhove outlines a simple framework: avoid, optimize, shift. First, identify more opportunities to ask, "Do I need to take this trip?" — the "avoid" element. If the trip is necessary, how can cities and towns ensure it happens as efficiently and effectively as possible? That's where optimization comes in. If the default mode is a private car, what incentives or measures can encourage a shift to more sustainable alternatives? Finally, the role of AVs: how can they be integrated into this broader mobility strategy? (For further insights, see ADL report "Mobility Demand Management: A Critical Tool to Influence Mobility Behavior," a companion piece to "The Future of Mobility 5.0.")

In cities where Waymo operates commercially, projections indicate a near one-to-one shift from Uber and taxi users following its deployment, according to Sarah Kaufman, Director of the Rudin Center for Transportation at New York University. In other words, it's not replacing cars — just drivers. This raises a potential concern: if autonomous taxi services drive down prices, they could draw riders away from public transit, ultimately increasing congestion and emissions.

But cities have an immense opportunity, Kaufman adds, to leverage AVs to address thorny operational challenges — and in doing so, improve their (often contentious) public image. "There's real potential to set up agreements where deployment means these companies also feed information back to the city," explains Kaufman. "Not just about the vehicle's safety, but also road conditions, like potholes, construction overstaying its permit, or unsafe intersections. That's data that cities can and should require."

MAKE MAAS WORK FOR YOUR CITY

For a time, the concept of an all-in-one mobility app was all the rage. A wave of startups rapidly entered urban markets, introducing everything from for-hire cars and bike-share programs to dockless e-scooters and shared vans. Integrating these services through a smartphone interface seemed like a natural step, especially as more aspects of daily life moved online.

Yet most systems remain fragmented. According to industry benchmarks, integration follows a tiered model: Level 0 offers basic information, like a train or bus schedule; Level 1 adds service consolidation, as seen in apps like Google Maps; Level 2 incorporates payment capabilities; Level 3 bundles services into a subscription; and Level 4 aligns mobility services with broader policy goals. For most of the world, what's available in your pocket is probably somewhere around Level 2 — a solution that cities and transit authorities have ceded to the private market.

There are exceptions, however. Jelbi in Berlin, Île-de-France Mobilités (IDFM) in Paris, and Floya in Brussels are examples of Level 3 MaaS platforms — enabling users to plan, book, and pay for multiple public and private mobility options within a single interface. Free Now (recently acquired by Lyft) offers a similar range of services in Germany. Meanwhile, ride-hailing companies such as Uber and Lyft are increasingly incorporating third-party mobility offerings alongside their own.

But most MaaS experiments have failed to take off, including Whim — the original MaaS app by MaaS Global, founded in 2017, suspended operations in 2024. And there isn't always one factor to blame. Dr. Philipp Seidel, Principal at ADL who studies new mobility services, lists several hurdles to consider. "How

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far did the technical evolution progress? What are the regulatory and legal questions? Then you have the business case: does it pay off? And what about the traffic system perspective? Does it solve congestion in and around cities? Does it solve accessibility or social problems? Does it solve the workforce bottlenecks?" (see ADL report "Beyond MaaS: How to Realize the Promise of Mobility-as-a-Service").

Full MaaS integration requires cities' transport authorities to both "frame" and "enable": providing the right vision, appropriate funding, and governance (framing) while ensuring proper enforcement toward shared and micromobility providers (enabling). Bus service may need expansion. One provider may resist revenue sharing with another. For MaaS to succeed, every cog in the system must work in sync — with a clear objective of shifting travel behavior. This is where additional policy levers, such as road pricing, congestion charges, and parking fees, become critical enablers. And that's before even factoring in AVs.

But the ideal of seamless, accessible transit that MaaS trumpets is gaining mainstream acceptance, Seidel points out. In most baseline scenarios today, transport providers offer digital tools to both plan and pay for trips, whether through mobile apps or contactless payment systems. While implementation varies, cities should still work to embed the core benefits of MaaS — greater transparency, ease of use, and improved connectivity — into the systems they oversee or regulate.

For Seidel, a city must care — because MaaS depends on cooperation and collaboration. "The political leadership of a city or transit agency has to embrace this technology from their perspective," he explains. "What's the performance of my urban mobility system? How quickly do I get people from A to B? And how satisfied are they?"



Cities should harness the dominance of the automobile to accelerate the transition toward more sustainable mobility, where cars become not the entire puzzle, but one important piece of it

AUGMENT THE AUTOMOBILE

For much of the past century, the urban mobility dream was shaped by the automobile. Even the name — from the Latin auto (self) and mobilis (moveable) — reinforces the idea of individual freedom and autonomy. Popular culture reflects this ideal, with cars gliding through empty roads and scenic landscapes in advertisements and films.

That dream came with consequences — rising carbon emissions, choked roads, and environments where access is limited to those with a car. Yet the automobile persists — supported by a strong business case. For many, owning a car remains just affordable enough, creating sustained demand for automakers selling millions of units each year. MaaS and AVs will need to compete in that same space. There must be a clear ROI — whether direct or indirect — that is easily understood and tangible to riders. They need to save time, money, or both. Until that value is delivered, MaaS adoption will remain limited, and AVs will largely be confined to players with the financial scale to sustain deployment — as we are seeing today.

The promise of frictionless, free-flowing movement hasn't disappeared — it's simply evolving. Cars are beginning to drive themselves. Smartphones can summon a ride in seconds. And mobility options are more abundant than ever. A shared solution is clearly more efficient: even EVs, which reduce emissions, do little to address the inefficiency of nearly 2 billion cars worldwide that sit idle 90% of the time.

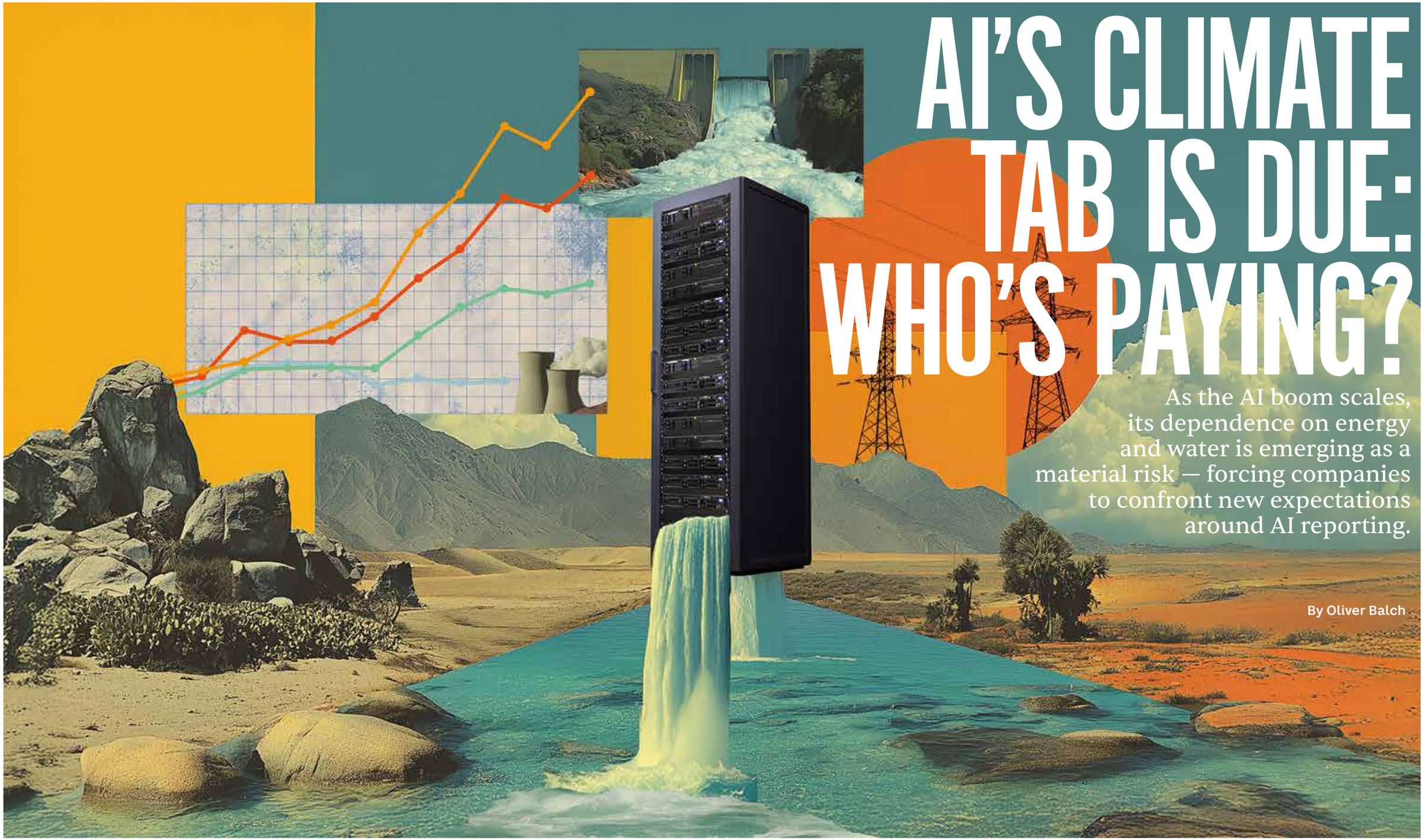
What comes next remains uncertain. But regardless of how the future unfolds, some realities persist: today, nearly 80% of all kilometers traveled are by car. Progress will need to be incremental — but measurable. Cities should harness the dominance of the automobile to accelerate the transition toward more sustainable mobility, where cars become not the entire puzzle, but one — still important — piece of it. After all, the most widely adopted form of transportation in history still has lessons to offer.

"The shared mobility system, which includes all mobility services but the private car, needs to be sufficiently attractive to be a possible alternative for users whose automobile is the default for all trips," says Van Audenhove. "It should embrace the car as part of the overall package, rather than positioning it in opposition to individual car use." ■

KEY TAKEAWAYS

- **Technology can be an enabler and accelerator** of virtuous mobility, but it will only do so if the key building blocks — vision, supply-demand management, and funding — are in place first.
- **Cities should work with private operators** to custom-fit concepts of MaaS for specific settings, with solutions that leverage other market mechanisms to substantially shift people away from private cars.
- **With AVs, cities should play the dual roles of regulator and enabler** by creating pathways for fair and safe usage.
- **The public sector should lay out clear policy goals** that AVs can help achieve, like reducing traffic and emissions, and pair public transit as a partner, not a foe.
- **To compete, MaaS and AVs will need to make the economics work** by adjusting prices and leveraging incentives.
- **Cars are here to stay,** so governments should consider ways to tap into their widespread usage and appeal to create more options for users.
- **Cities have a generational opportunity to catalyze change** through MaaS and AVs to offer a shared solution that's more efficient for all — and they should develop these solutions now, before it's too late.

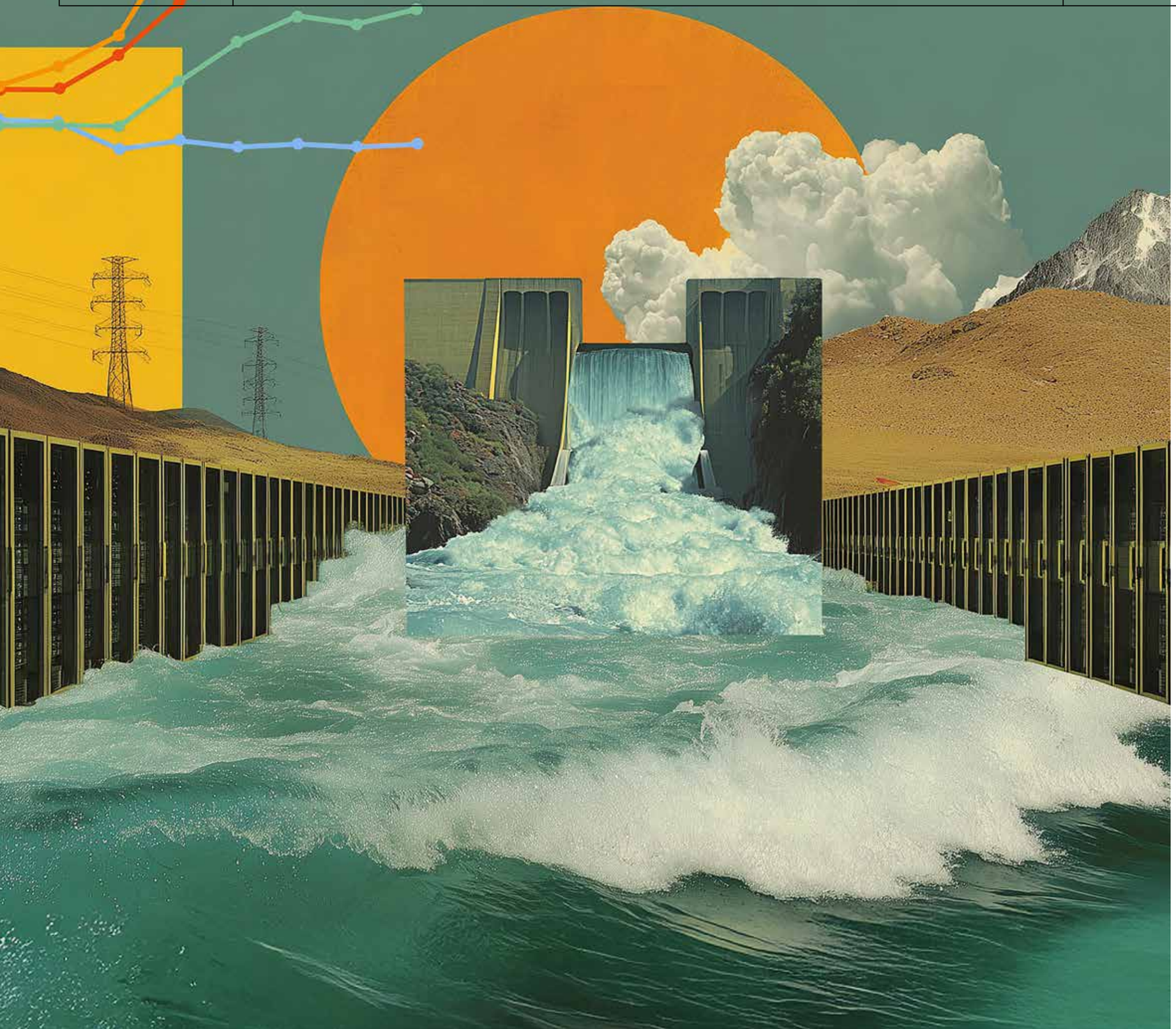
John Surico is a journalist and researcher focused on cities and urban change. His writing has appeared in *The New York Times*, *Bloomberg CityLab*, *New York Magazine*, and other leading publications. He is an Adjunct Professor at NYU's Arthur L. Carter Journalism Institute and a Senior Fellow for Climate and Opportunity at the Center for an Urban Future.



AI'S CLIMATE TAB IS DUE: WHO'S PAYING?

As the AI boom scales, its dependence on energy and water is emerging as a material risk — forcing companies to confront new expectations around AI reporting.

By Oliver Balch



Talk of an AI boom is everywhere — not because AI itself is new. Businesses have been using chatbots and general-purpose assistants for well over a decade. Rather, the recent mainstreaming of GenAI is ramping up the sophistication of AI applications.

It's not just talk, either. Business expenditure on AI tools clearly reflects a dramatic rise in adoption. In 2021, before the launch of OpenAI's ChatGPT, annual corporate spending on AI software hovered around $33 billion a year. In 2025, that number grew to about $300 billion.

Although that type of spending speaks to the value of GenAI to business, the serious expenditure is unfolding on the hardware and infrastructure side. This year, total investment in data center hardware, servers, and storage is expected to reach $1.37 trillion. These "nuts and bolts" of the AI ecosystem are vital to propping up the GenAI tools increasingly being deployed in companies around the world. (For more on the AI-driven surge in data center and compute infrastructure, see ADL Viewpoint "Giga Scale: The AI Infrastructure Gold Rush.")

But there's a problem. Generating huge computational power to make cutting-edge AI tools work requires vast amounts of electricity (for power) and water (for cooling). Both come at high environmental costs (see PRISM article "Will an Energy Crunch Stop the AI Revolution in Its Tracks?").

"AI's Hidden Dependencies," a recent ADL Blue Shift report, brings these costs into sharp relief. For example, AI data centers are expected to use nearly double the amount of electricity in 2030 as they did in 2024. The trajectory for water use is similarly dramatic.

To provide a taste of what lies ahead, Albert Meige, ADL's Director of Blue Shift, points to the evolution of ChatGPT. "If you do a query on GPT-4, it uses about the same energy as a standard Web search. Do that same query on GPT-5, and the energy use is 90 times as much."

PRESSURE TO ACT

So, who is responsible for AI's eco-impacts? "Not us," conventional businesses might well say. They are just the consumers of

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AI tools and services, after all. Many say responsibility lies with the owners and developers of this revolutionary technology — Google, Microsoft, Amazon Web Services, Meta, and other hyperscalers.

That argument is unlikely to wash with an increasingly jittery public, warns Meige. Wait until residents close to data centers find their taps running dry, he says. Or when households in vulnerable parts of the grid see their electricity bills going up. "At some point, the physical realities of AI use are going to knock on people's doors, and they'll want to know what companies are doing about it," he says.

Some regulators are putting business users front and center. Under the EU's Corporate Sustainability Reporting Directive (CSRD), large European businesses must report on the indirect environmental impacts linked to their energy and water consumption — a list that includes their AI use.

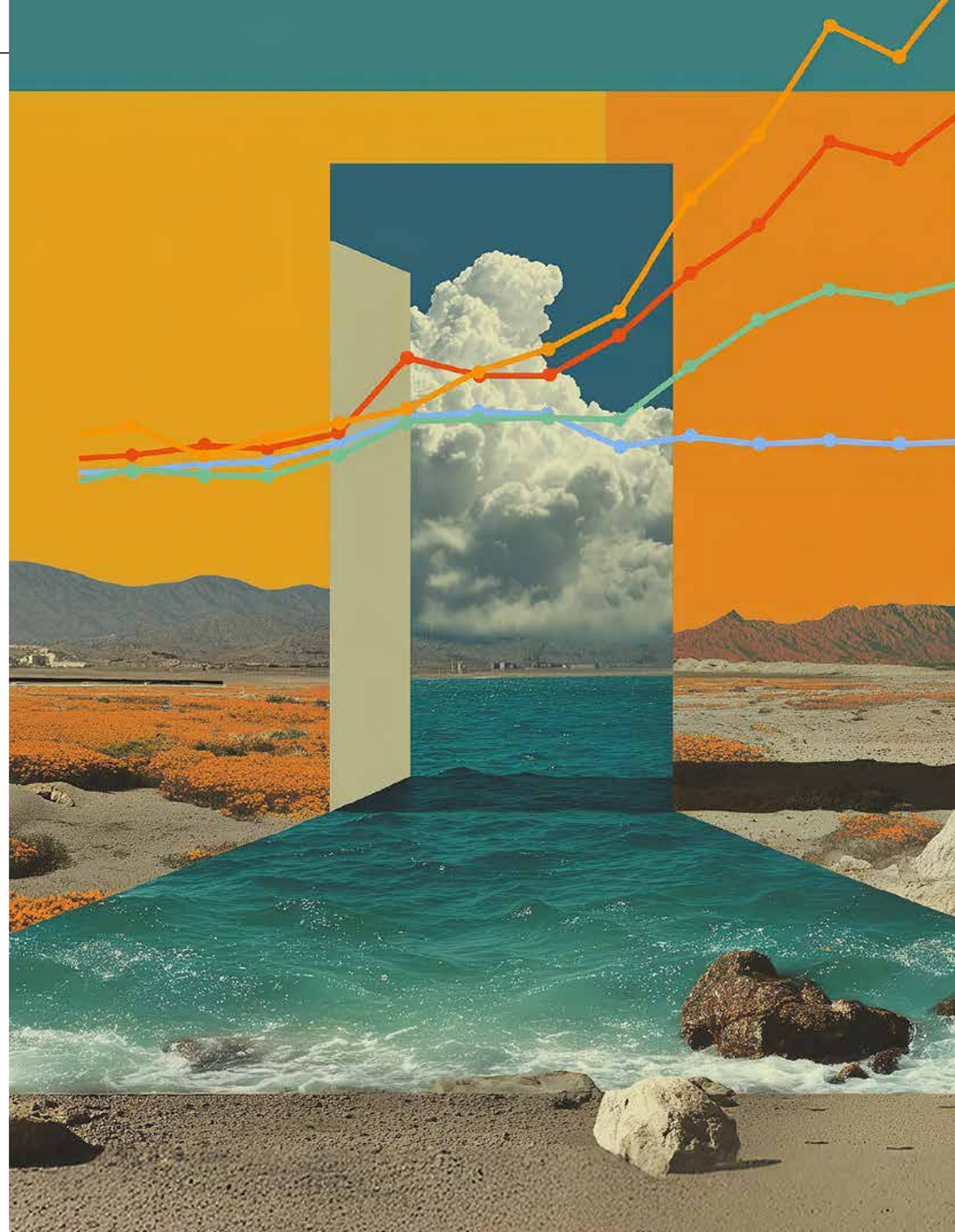
And it's not just external pressures making AI's environmental record a priority for business; internal considerations are also at play. AI tools are already deeply embedded in most companies' everyday operations. Should climate change issues somehow lead to limits on accessing these tools, the operations and profitability of these businesses could be seriously compromised.

Concerns over water availability have already led to new data centers being blocked in countries as diverse as Malaysia, Chile, and the Netherlands. Similar pressure is mounting in the US, where around two-thirds of applications for new US data centers are in water-stressed regions. Fears over grid disruptions are causing many planning authorities to rethink their strategies. (For more on the grid-side realities behind rising demand, and how stakeholders can translate constraints into investment and resilience opportunities, see ADL Viewpoint "Turning Grid Challenges into Opportunities.")

DON'T WAIT

What should companies focus on? Florence Carlot, Partner in ADL's Energy, Utilities & Resources practice, says strategic resilience should be a top priority. Companies should be

"At some point, the physical realities of AI use are going to knock on people's doors, and they'll want to know what companies are doing about it"



increasing their flexibility and "portability" in relation to AI, she says. A good option here is designing AI architectures that segment workloads across on-premises, sovereign, and public AI platforms. Another is using architectures and formats that can migrate between clouds, vendors, or regions.

Companies should consider diversifying providers to spread their risk of operational complications should an unexpected point of failure occur. Within this wider supplier base, they might consider negotiating more flexible terms in the event of unforeseen disruptions (think export bans, resource shortages, and demand shocks). Routine stress tests in anticipation of such eventualities are high on Carlot's should-do list.

Of course, this presupposes a business knows where it currently stands. If not, leadership is flying blind. This makes managing AI-related vulnerabilities almost impossible; the same goes for accounting for AI-linked environmental impacts. The possibility of radical innovation is also greatly reduced. Advances in clean energy and other climate-smart solutions, for example, make a net zero AI ecosystem theoretically possible. But to arrive at such a future, it's necessary to draw a pathway to there from the present — a difficult challenge for those whose current situation remains opaque.

Interestingly, AI's analytical power could be used to project backward, so as to redesign its own lower-carbon future, says Lukas Falcke, Assistant Professor of Digital Strategy and Innovation at VU Amsterdam, the Netherlands, and a leading advocate of digital-first solutions. Doing so, however, requires a proactive, opportunity-focused approach to auditing and reporting.

"With a digital-first mindset, it's almost like the future becomes your starting point, because with AI you can more or less predict what emissions you will create and where, which allows you to work back from there," Falcke says. "So instead of seeing reporting as compliance, look at it as a data-driven iteration toward a reimagined future." (For a broader lens on using digital innovation for sustainability, see ADL's Amplify issue "Charting a Sustainable Future with Digital-First Solutions.")

Companies should expect reporting requirements for AI-related risks and impacts to tighten in the future

For AI's corporate users, gaining a clear picture of the present is harder than it sounds. As the Blue Shift report points out, obtaining meaningful data from AI operators is difficult. Fewer than 3% of new AI models disclose environmental data, down from 10% in 2023.

Not only is current data scarce, but AI providers tend to aggregate the little data they make available. This makes it tricky for companies to work out the emissions or water footprint linked to specific data centers or particular AI tools, complicating their ability to calculate the impacts of their individual AI usage.

Nevertheless, Carlot counsels against a wait-and-see approach to disclosure. Companies should also expect requirements to report on their AI-related risks and impacts to tighten in the future, she says. "Exactly when is hard to say in some jurisdictions, but there's no doubt it will happen."

PREPARING TO REPORT

Carlot outlines three basic measures all companies should undertake. The first and most obvious is mapping their AI touchpoints. What AI tools are they currently using? What's the respective purpose and importance of these tools? Which vendors are they most reliant on? Do these vendors also operate data centers and, if not, who does? "Every company needs to build a basic AI inventory based on questions like these," she says. "That creates a baseline for their material impacts along the AI value chain, which they can then use to report back."

Steps two and three involve putting hard numbers against this inventory and stress-testing them against various scenarios. Once completed, companies should find themselves with the requisite data to set realistic targets for reducing the environmental price tag of their AI use. Carlot says that for many companies, obtaining such data requires prior steps. For example, as part of the contract-setting process with AI vendors, she suggests firms make the provision of environmental data a nonnegotiable criterion.

This demand is entirely reasonable, Carlot explains, because the expense of electricity and water means that AI firms' usage is carefully tracked. In addition, as more companies request this data, smart AI providers will realize that eco-disclosure can be a competitive differentiator.

Companies should also consider engaging at one level up: the AI industry level. For auditing and decision-making purposes, it is important that site- and product-level information can be compared across various providers. Otherwise, companies will find themselves trying to "measure apples against oranges."

Ideally, says Carlot, the AI industry would agree on a shared methodology for reporting planetary impacts. With reporting norms for AI firms still taking shape, proponents argue that an industry-led framework could serve as a model for legislators.

Armand Smits, Assistant Professor of Organizational Change and Design at Radboud University, the Netherlands, sees merit in such a position, but recent experience in Europe suggests trust could present a hurdle. Under the umbrella of the Climate Neutral Data Centre Pact (CNDCP), more than 100 data center operators and trade associations came together in 2021 to agree on common environmental targets and measures (see ADL Amplify article "Establishing Collective Environmental Self-Regulation in Fragmented Digital Spaces"). To date, EU legislators have not been "that supportive" of CNDCP's proposals, Smits says.

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"On the plus side, the CNDCP initiative signals acceptance in the AI sector about the demand from regulators for them to report more," he says. "On the downside, the opposition from NGOs and local governments to AI operators being involved in setting standards shows a high level of distrust toward the industry."

THE PUSH FOR TRANSPARENCY

Corporate AI users are uniquely positioned to intervene, leveraging their commercial relationships with AI providers to push them to make their datasets more open. At the same time, by making public their requests, companies can signal their intent to be transparent and get ahead of criticism or distrust about their AI-related impacts.

Reporting on AI-use impacts isn't easy. Standards remain inconsistent, legal requirements are still evolving, and (most significantly) auditable data is fragmented and hard to come by. Nonetheless, getting themselves ready to report is a task all companies must confront. ■

KEY TAKEAWAYS

- **GenAI tools are driving a massive uptick** in business spend on AI software, turning AI use into a significant driver of global water and electricity use.
- **AI's water and electric dependencies** come with growing ecological costs. Although primary responsibility for these costs falls on AI owners, business users are not exempt.
- **To strengthen their environmental credibility**, companies should prepare to disclose their true AI-use footprint. Acting now is the best way to get ahead of future regulation.
- **Greater visibility into companies' AI footprint** can prompt innovation and create resilience, including opportunities to deploy sustainable solutions to reduce AI-related risks and dependencies.
- **Companies should start** by conducting an inventory of their AI use, which provides a baseline that can be used to set targets and stress-test against future scenarios.
- **Obtaining this data** may require companies to directly engage with AI providers, and factoring disclosure into AI purchasing agreements can be a powerful lever here.

QUESTIONS

TO CONTINUE THE CONVERSATION

We hope you found this year's PRISM articles insightful. Together, they highlight key themes we think leaders should be exploring now.

Are you striking the right balance between enhancement and reinvention?

As technology cycles accelerate, businesses must move faster to keep pace. But quick wins and efficiencies won't secure long-term advantage. *Reinvention carries risk and cost — but what's the cost of not doing enough?*

How much of your future do you actually control?

Cloud, AI, energy, and critical infrastructure increasingly depend on a small number of external providers, creating critical dependencies for many businesses. *Do you know which capabilities, assets, and relationships are too critical to leave outside your control?*

Are you focusing enough on what it takes to make new technology work?

Across industries, businesses integrating AI and automation often focus too much on the technology and not enough on the operating model and people around it. *Are you investing enough in the governance, incentives, economics, skills, and behaviors needed to make transformation work?*

Are you prepared for the rising physical costs of your digital ambitions?

For now, AI and automation can seem relatively inexpensive. But as climate impacts escalate, grid constraints intensify, and the true cost of digital resource use comes into focus, that will change. *Is your business resilient enough for what's ahead?*

What does your organization need to unlearn?

Many of today's structures, processes, and assumptions were built for a more predictable world. Their past success can make them especially difficult to challenge. *Are the beliefs that made your organization successful in the past holding it back today?*

Finally, we'd love to hear your feedback on this year's PRISM.

Please scan the QR code or contact us at prism@adlittle.com.

We wish you every success in the year ahead!
PRISM Editorial Team

ARTHUR D LITTLE

