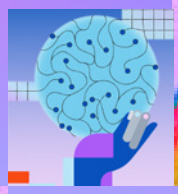
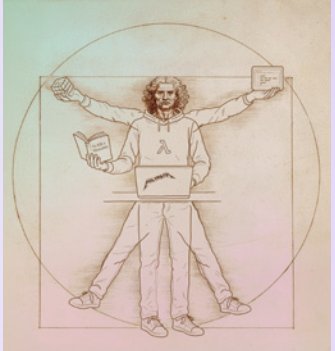
WERNER VOGELS'

Tech Predictions for 2026 and Beyond

Dr. Werner Vogels
VP & CTO, Amazon.com



CONTENTS

Looking ahead to 2026 and beyond

For much of the world, technology has become so intertwined with our day-to-day lives that it influences everything. Our relationships, the care we seek, how we work, what we do to protect ourselves, even the things we choose to learn and when. It would be understandable to read this as a dystopian nightmare conjured up by E.M. Forster or Ernest Cline. Yet, we are on the verge of something fundamentally different. We've caught glimpses of a future that values autonomy, empathy, and individual expertise. Where interdisciplinary cooperation influences discovery and creation at an unrelenting pace. In the coming year, we will begin the transition into a new era of AI in the human loop, not the other way around. This cycle will create massive opportunities to solve problems that truly matter. And it starts by addressing one of the unintended consequences of our hyperconnected world—loneliness and a lack of companionship—by turning the very force that created the problem into the solution

PREDICTION | 01

Companionship is redefined for those who need it most

Loneliness has reached epidemic proportions, affecting 1 in 6 people worldwide and designated as a public health crisis by the World Health Organization. In fact, social isolation increases death risk by 32%, comparable to smoking, while loneliness increases dementia risk by 31% and stroke risk by 30%. The crisis is particularly acute among the elderly, where 43% of adults aged 60 and older report loneliness, and the effects becoming more severe for those 80 and older. As aging populations strain care systems globally, we stand at the threshold of a profound transformation in human-technology relationships, one that directly addresses this loneliness epidemic through genuine emotional connection.

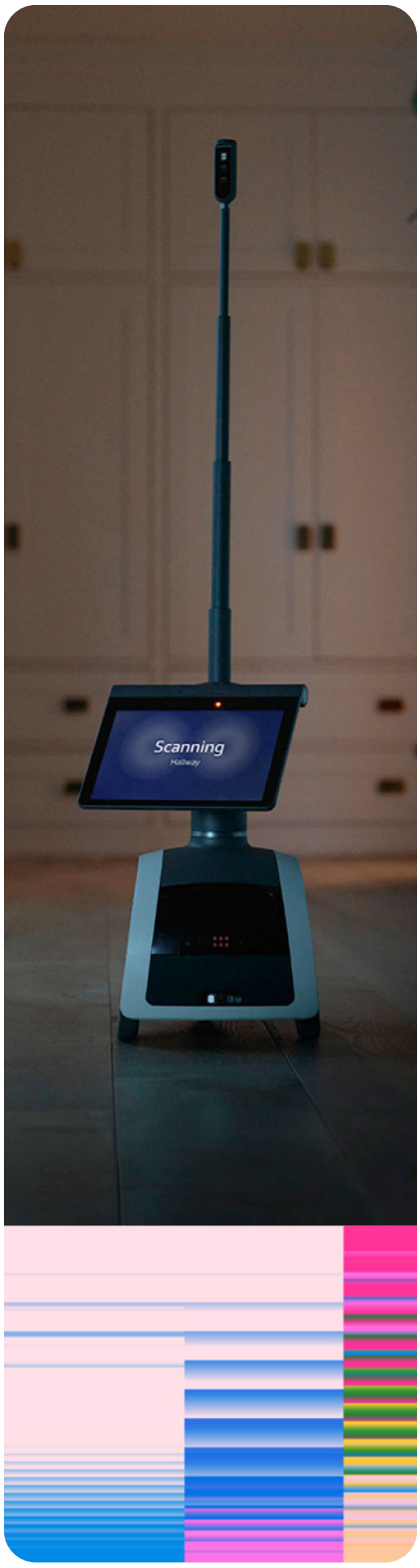
Just a decade ago, forming meaningful emotional relationships with robots was science fiction. Today, the convergence of aging demographics, advanced AI capabilities, and a global loneliness epidemic have created the perfect conditions for a companionship revolution. We are witnessing a shift from transactional device interactions to relationship-building with physical AI that demonstrates increasingly nuanced emotional intelligence and responsive behaviors.

Clinical evidence supporting the effectiveness of combating loneliness with companion robots is compelling. In Canada, long-term care facilities and hospitals have adopted robots like Pepper, Paro, and Lovot to support mental health and wellbeing. In fact, a clinical study of Paro found that 95% of dementia participants that regularly interacted with these companions had beneficial interactions—with measurable reductions in agitation, depression, and loneliness. They also noted decreased medication usage and improved sleep patterns. However, the therapeutic impact of companion robots isn't limited to elderly patients. Research with the Huggable social robot at Boston Children's Hospital showed that pediatric patients were significantly more eager to emotionally connect and interact with a robot than a virtual character on screen or attending staff. In one particularly striking case, a child who typically became extremely distressed during medication administration remained calm and engaged with the Huggable robot, making the previously traumatic process nearly effortless.

What makes these robots so effective at fighting loneliness and making connections with us? We're biologically hardwired to project intent and life onto any movement in our physical space that seems autonomous to us. As MIT researcher Kate Darling discovered.

> People treat robots more like animals than devices. We name them, we feel protective of them, and we form genuine emotional bonds with them.

This isn't limited to sophisticated humanoid robots: between 50-80% of Roomba owners name their vacuum cleaners as if they're family members. When something moves freely and with purpose through our space, expressing what appears to be personality and intent, we instinctively respond by building relationships. This biological response creates the foundation for companion robots to provide the consistent emotional presence that alleviates loneliness in ways that traditional devices simply cannot.



At Amazon, our Astro team has documented people building non-transactional relationships with companion robots over time. Unlike traditional smart home devices, Astro's mobility, expressive visual interface, and proactive capabilities—like navigating the house to find you for medication reminders or family check-ins—create genuine attachments. The robot's ability to convey emotions through head movements and facial expressions creates an anthropomorphic presence that resonates deeply with users. We've observed families naming Astro, treating it as a family member, and experiencing noticeable longing when temporarily removed, representing a fundamental shift from viewing robots as tools to accepting them as companions.

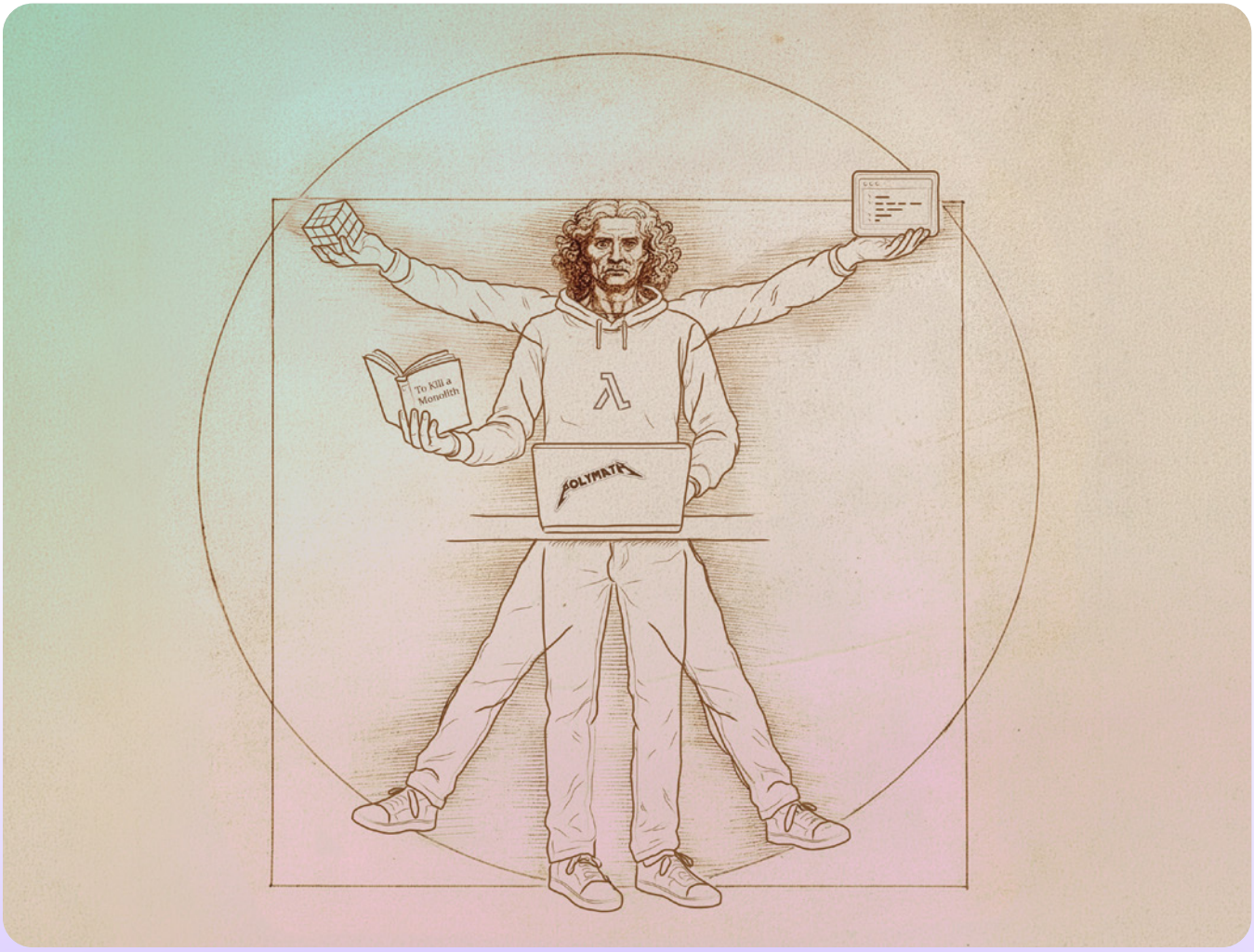
One case we observed involves a disabled child whose family purchased Astro for companionship during periods when professional care wasn't available. The robot provided consistent presence and interaction, addressing critical care gaps while reducing emotional and financial burden on the family. Companion robots have advanced to the point that they are able to provide both practical care support and make meaningful emotional connections that combat isolation.

Rather than replacing human caregivers, this companion revolution creates a collaborative model where technology and people work in tandem to provide care and fight loneliness. Robots will handle routine monitoring and provide steady emotional presence, offering the kind of consistent, judgment-free companionship that alleviates isolation, while allowing humans to focus on complex decision-making and nurturing deeper relationships. As people form deep trust with these robotic companions, the companies building them must implement strong controls to ensure these robots never exploit that trust to influence users' decisions or shape their beliefs. When developed responsibly with these safeguards in place, this represents technology at its best: keeping people central to care while extending our capacity to support those who need it most.

PREDICTION | 02

The dawn of the renaissance developer

Tools change, but the fundamentals endure. As generative AI reshapes how we build software, a familiar trope has re-emerged, the narrative that developers will become obsolete. But if history has taught us anything, this is not the end of the developer, it's the dawn of something new, the renaissance developer.



You've heard the rumblings. Read the headlines telling us that AI will make developers obsolete. That anyone can code now. Just describe what you want to do, and tools will take care of the rest. That the era of the professional developer is over.

We've seen and heard this before. Early assembly programmers were told that compilers would make them redundant. Instead, compilers elevated the level of abstraction and opened software development to far more people. What once required deep hardware expertise became an act of logic and creativity. Entire industries emerged because software became something many could build. Businesses, research labs, and universities suddenly had the ability to create their own tools.

In the 2000s, operations engineers expressed similar concerns when cloud computing arrived. They feared automation would make them obsolete. Instead, it lowered barriers to experimentation and created an explosion of new projects, new companies, and new engineering roles. Every simplification produced greater demand.

Each technological leap forward has followed a similar pattern. Tools evolve, workflows change, and complexity increases, yet the core attributes of great developers remain constant. Creativity, curiosity, and systems thinking have continued to define the craft.

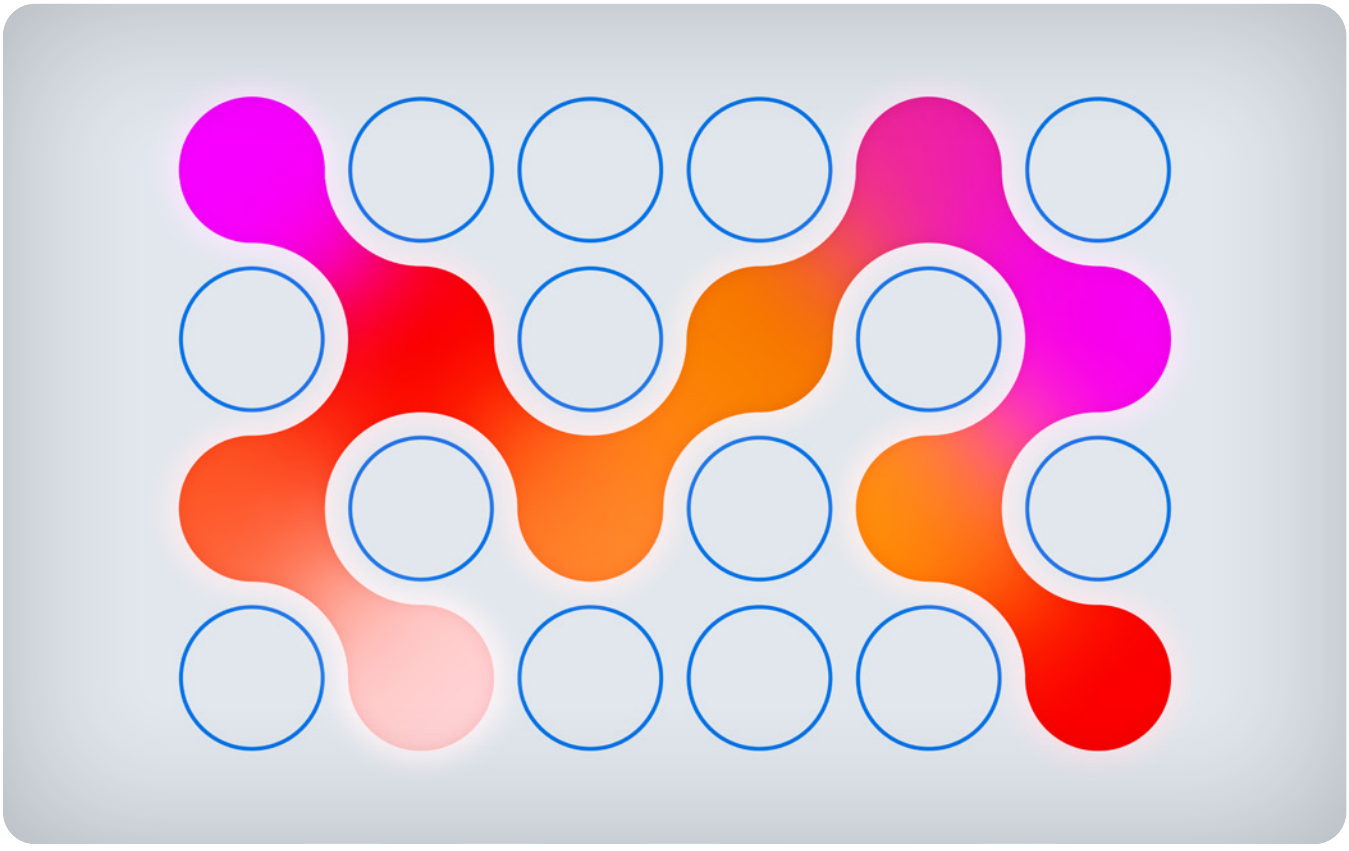
Time and time again we have seen that lowering the barrier for entry doesn't eliminate the need for human expertise, it amplifies it. Generative AI lets us generate code in seconds, but if you put garbage in, you get really convincing garbage out. The AI doesn't sit in budget meetings where leadership debates whether to optimize for cost or performance. It doesn't understand that the customer service system needs five 9's of uptime while the internal reporting dashboard can go down during peak sales periods. It can't read between the lines when a stakeholder says, "make it fast" but might mean "make it cheap." The politics, the constraints, the unspoken priorities that shape every technical decision are nuanced and require a developer who understands why it matters to the humans who pay for it and the humans that will use it.

Before Leonardo DaVinci painted the Mona Lisa, he dissected cadavers to understand muscle structure, studied water flow to design canal systems, and observed birds to imagine flying machines.

His Vitruvian Man was more than art—it was a diagram of proportions and a philosophical statement about humanity's place in the world. Like the Renaissance greats who combined art, science, and engineering, the developers who thrive in this AI-augmented world must become modern polymaths – renaissance developers.

They understand that systems are living, dynamic environments where changes ripple through services, APIs, databases, infrastructure, and people. They communicate with clarity that both humans and machines can build from. They own the quality, safety, and intent of what they create, especially as AI grows more confident in its errors. They bring domain knowledge that AI cannot replicate, such as understanding the business, the customer, and the real-world constraints that matter. They never stop learning.

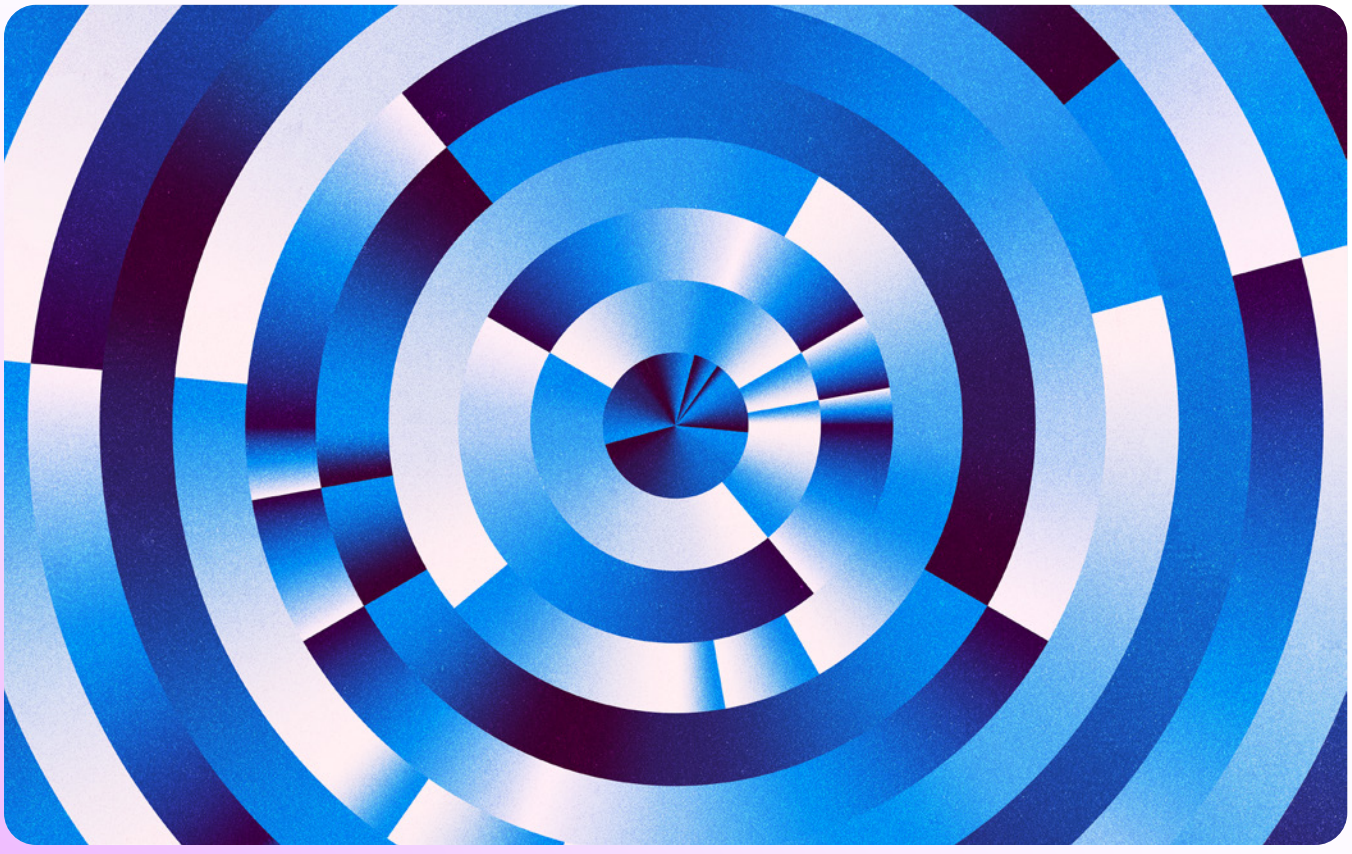
The fundamentals that have always made great developers remain unchanged. But like the great thinkers of the Renaissance who refused to be confined to a single discipline, developers can no longer live in silos. You must think bigger, the moment demands it. This is the dawn of a new age for developers. You have never been more valuable. Your creativity has never been needed more. So keep building, stay curious, and keep solving the world's hardest problems.



PREDICTION | 03

Quantum-safe becomes the only safe

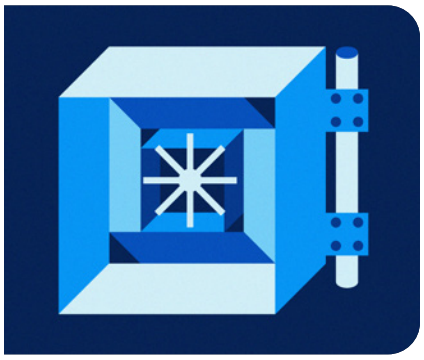
Personal data, financial records, and state secrets are already being harvested by malicious actors betting on quantum's arrival. For most organizations, the reasonable assumption was that they had years to plan. That assumption no longer holds. Advances in error correction and algorithmic efficiency have compressed timelines, and the window for proactive defense is closing. The coming year requires post-quantum thinking; from the cryptography protecting our most sensitive communications to the education necessary to train quantum engineers.



There was a time not too long ago, when people actually weren't sure that quantum computers could even exist. Even three years ago, when I spoke with Dr. Preskill, the timelines for hardware that could solve hard problems seemed to be decades away. Since then, we've started to see timelines compress.

As of late, we've witnessed a series of major improvements to both quantum hardware and architectures. AWS unveiled Ocelot, a quantum chip demonstrating hardware-efficient quantum error correction that reduced overhead by up to 90% compared to conventional approaches. Google's Willow chip proved error rates decrease exponentially with code distance. IBM announced a framework for fault-tolerant quantum computing by 2029. Error correction has long been the primary challenge to building a scalable quantum computer, and development is accelerating. And while quantum computing brings with it the promise of breakthroughs in everything from medical research to investing, one area that we need to take seriously right now is security. The risk lies in how we secure data today.

Malicious actors have been harvesting encrypted data for years, patiently waiting for the computing power necessary to decrypt it.



Most of our digital security relies on public-key cryptography, and the mathematical puzzles that make RSA and elliptic curve encryption hard for classical computers to solve will be trivial for quantum machines running algorithms like Shor's. Unlike symmetric encryption, which can be strengthened with longer keys, public-key systems need entirely new mathematical foundations to survive the quantum era.

A research paper from this May showed that 2048-bit RSA integers can be factored with less than one million noisy qubits, a 95% reduction from the 20 million estimated just six years earlier. It's plausible that in about five years, there will be quantum computers capable of breaking the RSA and ECC encryption that secures the vast majority of internet communications, financial transactions, and your sensitive personal data.

Preparation isn't something you can put off, the work must begin now, and organizations need to act on three fronts: deploying post-quantum cryptography (PQC) where we can, planning to update and replace physical infrastructure where we can't, and developing quantum ready talent to support this transition.

The good news is that PQC solutions exist and are deployable now at the OS level, the browser level, and in the cloud. Major tech companies are converging on NIST standards like ML-KEM (Module-Lattice-Based Key-Encapsulation Mechanism), ensuring interoperability and security. Microsoft released post-quantum tools for Windows and Linux. Apple integrated quantum-safe protocols into recent iOS and macOS releases. Google switched Chrome to quantum-resistant encryption. AWS deployed the standard across KMS (Key Management Service), ACM (Certificate Manager), CloudFront, Secrets Manager, as well as AWS-LC. And detailed migration plans exist. But these are just the first steps.

The physical world is where the transition becomes most complex. Think of how many devices on your home network: your smart television, your thermostat, your connected refrigerator? Everywhere around us are systems that rely on encryption, like the key system at the last hotel you stayed at. Utilities deployed millions of smart meters that use current encryption standards but lack the processing power to run post-quantum algorithms. Power grids, water treatment systems, and transportation networks face similar constraints with embedded devices that cannot be easily upgraded. Multiply that across millions of devices requiring physical updates, and the scale becomes clear.

This constraint will force companies to get creative. Expect hybrid approaches that layer quantum-safe gateways in front of legacy devices, and new deployment models that sequence hardware refreshes without disrupting critical services. This is no longer an IT security project. It's a cross-functional transformation spanning engineering, logistics, manufacturing, and operations.

Finally, there's talent. The UK Quantum Skill Taskforce report estimates that 250,000 new quantum computing jobs will be created by 2030, and that the number will explode to 840,000 by 2035. As I wrote two years ago, "Higher education alone cannot keep up with the rate of technological change." Organizations that invest in quantum education and training now will build competitive advantages that cannot be easily replicated. The quantum era requires a new blend of expertise that is rare today, but will be table stakes in the next few years. The challenge for businesses will be incentivizing people to specialize in quantum, whether in university or through alternate education paths.

Quantum is much closer than we had collectively imagined. Those that embrace holistic quantum readiness—implementing post-quantum cryptography, developing quantum talent, and planning physical infrastructure transitions—will protect their data and unlock new capabilities in secure computation, privacy-preserving AI, and trusted data sharing. Cloud-native organizations will transition smoothly through provider-managed updates. Infrastructure-heavy companies that begin planning physical transitions now will survive. Those that delay now will face vulnerabilities with no viable remediation path when quantum computers mature. It won't be long before quantum-safe is the only safe.

250k

The UK Quantum Skill Taskforce report estimates that 250,000 new quantum computing jobs will be created by 2030.

Defense technology changes the world

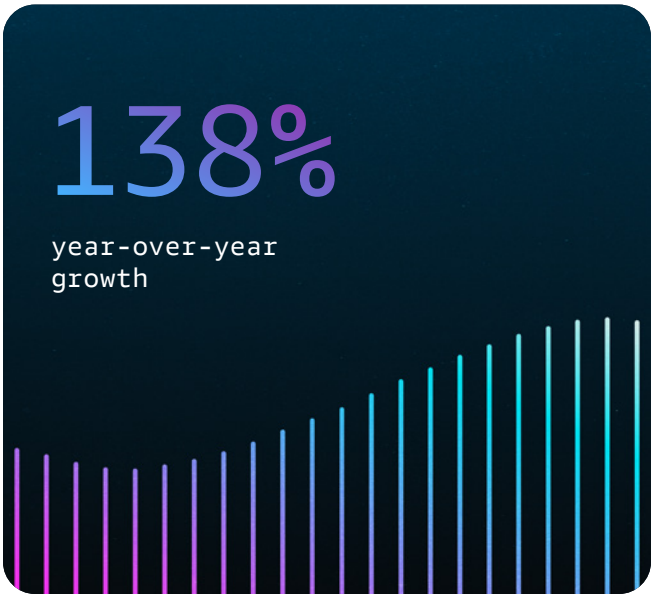
War has changed over the course of my lifetime. Hand-to-hand conflict is now a last resort. Wars are fought from behind screens, hundreds, sometimes thousands of miles away, with controllers, keyboards, and clicks of a mouse. Military investment in technology is surging, both by governments and in the private sector. The speed of innovation has significantly increased, and in the coming years we will see the timeline from battlefield to civilian application compressed, and it will fundamentally reshape infrastructure, emergency response, and healthcare worldwide.

The lineage of transformative civilian technologies born from military necessity is remarkable. Admiral Grace Hopper's pioneering work on the Mark I computer for the Navy led to the development of COBOL, which powered business systems for decades. DARPA's research gave us the internet and GPS, technologies so integral to our daily lives that we forget their military origins. Radar technology, developed in the mid-1930s by the United Kingdom, evolved into air traffic control systems and, unexpectedly, the microwave oven. The EpiPen originated from Cold War nerve agent antidote research, and now, millions of people rely on it every day.

However, it's often been a trickle. Successful transitions from battlefield to civilian life demand significant cost reduction, manufacturing improvements, and clear market validation before they are commercial viability. Historically, this process has taken anywhere from 10 to 20 years. This is where things are changing.

What's different now isn't the scale of investment, it's the fundamental approach to innovation. Companies like Anduril Industries, which reached $1 billion in revenue in 2024 with 138% year-over-year growth, and Shield AI, with $267 million in 2024 revenue, operate more like technology startups than traditional defense contractors. They design technologies as dual-use from inception, seeing civilian applications not as afterthoughts but as core business models. This shift eliminates the traditional adaptation phase that historically added years to the transfer timeline.

Consider what's happening in conflict zones around the world, where technologies are being refined under extreme pressure. Software updates for autonomous systems happen weekly, not annually. AI algorithms learn from real-world data and improve overnight. This creates feedback loops measured in days rather than decades. When a Ukrainian farmer uses a consumer drone for reconnaissance, then shares intelligence through encrypted messaging apps, we're witnessing military and civilian technology converging in real time.



Beyond conflict zones, the night vision systems, once exclusive to special forces, now guide search-and-rescue helicopters and enable wildlife conservation efforts. Tactical edge computing, refined for operations in disconnected environments, powers remote healthcare clinics and industrial operations in areas with limited infrastructure. Autonomous systems developed for military logistics are being adapted to solve agricultural labor challenges while making food production more efficient and sustainable, with immediate applications in power plants, wind farms, search and rescue operations, and maritime port security. Military robotics innovations are driving solutions with urgent humanitarian applications across industries that affect billions of people.

Healthcare systems, emergency services, and infrastructure operators should prepare for capabilities that will emerge from current defense investments within the next two years, not two decades. The organizations that understand this accelerated timeline will gain significant advantages in solving critical problems, from disaster response and food security to healthcare access in remote regions.

The technologies being refined under extreme pressure today won't wait for peacetime to reach the masses. They're arriving now, designed from the start to serve both military and civilian needs. The old model of decades-long adaptation cycles is being replaced by direct deployment pathways. The organizations that recognize this isn't evolution—it's disruption—will be the ones solving problems that affect billions of people.

PREDICTION | 05

Personalized learning meets infinite curiosity

Every student deserves an educator who knows exactly how they learn best, who can engage their curiosity, honor their individuality, and nurture their creativity. For most of human history, only the wealthy could afford a personal tutor. That's about to change.

I think back to my own education. The moments that mattered most weren't lectures in crowded classrooms. They were conversations with teachers who took time to understand how I thought, what confused me, and how to explain something in a way that made sense specifically to me. Those teachers were rare.

For most students around the world, personalized attention remains a luxury. School was built for efficiency, not diversity. We organized education around conformity. Standardizing what students learn, when they learn it, and how we measure success. Education researcher Sir Ken Robinson spent decades documenting how traditional systems organize around conformity rather than diversity, compliance rather than curiosity. He observed that in some parts of America, 60% of students drop out of high school. But the dropout crisis is just the tip of the iceberg. What it doesn't count are all the kids who are in school but disengaged from it, who don't enjoy it, who don't get any real benefit from it.

60%

Sir Ken Robinson observed that in some parts of America, 60% of students drop out of high school. But this is just the tip of the iceberg.

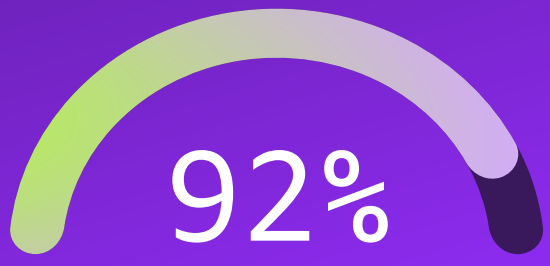
AI has the power to fundamentally change the way that we approach education. Children are natural learners. They will pepper you with questions until you cry uncle. The only limit to their curiosity is access to people and tools that can answer their questions. So, instead of forcing every student through the same system and learning sequence, AI will adapt to how each child thinks. Answering "why?" as many times as a student asks, exploring tangents that spark interest, adjusting explanations until something clicks. It creates safe spaces where students can fail, try again, and ask questions without judgment. And it's not just STEM, AI enables students to explore the arts, languages, music, and humanities. Most importantly, it does what great teachers have always done: it engages each student's natural love of learning rather than suppressing it.

A student can now access tutoring from an AI system for $4 per month. Khan Academy's Khanmigo exceeded all projections by 1,400%, reaching 1.4 million students in its first year. Anthropic launched the world's first nation-wide AI education pilots in Iceland. According to a UK survey through UCAS, the proportion of students reporting using any AI tool has jumped from 66% last year to 92% this year. These aren't experiments—they're production systems at scale. And this transformation is happening in India, Brazil, and across Africa. Physics Wallah serves 46 million students with 250% revenue growth. UNESCO's CogLabs operates across 35 countries using smartphones students already own. Here at Amazon, we launched a $100 million Education Equity Initiative to help underserved students gain skills in AI.

Generation Alpha is already thinking about AI differently than we do. During a recent TEDx talk, cultural anthropologist Rob Scotland tells the story of three sixteen-year-olds caught engineering their own curriculum with ChatGPT and TikTok during math class. When asked why, they said: "We wanted to try something else."

For adults, AI is a tool. For Generation Alpha, it's an extension of thinking. They've deleted "impossible" from their operating system and replaced it with "not yet." AI tutoring works because it nurtures that curiosity. Students demonstrate 65% increased willingness to attempt challenging tasks using AI tools. Duke University found AI-assisted intervention increased IQ scores in children with autism by up to 17 points. These aren't just better test scores. They're students who approach difficulty itself differently because they learned in environments where "I don't know yet" is a starting point, not a failure.

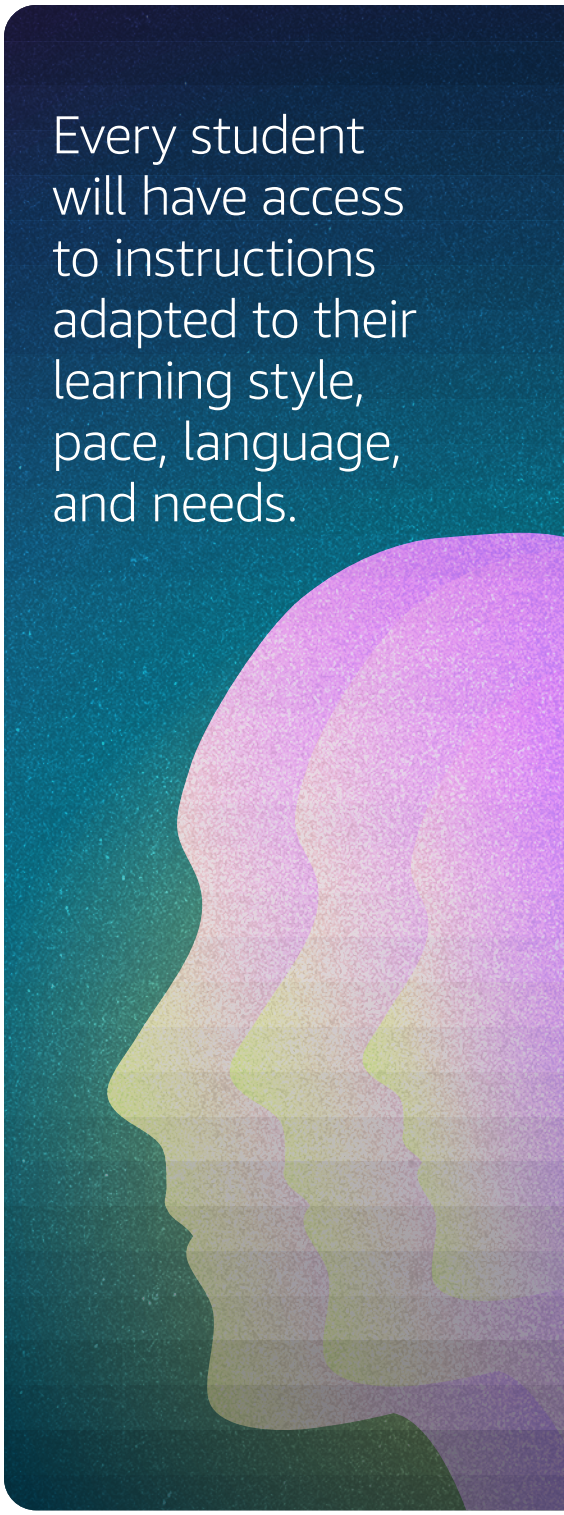
UCAS reports that students using AI tools have jumped from 66% last year to 92% this year.



To be clear, teachers are NOT going away. What's changing is what teachers do. We are in the midst of a global teacher shortage, and teachers should not have to spend the majority of their time on tasks that scale poorly (and can be automated)—grading, administration, answering routine questions over and over. AI is freeing them from that heavy lifting while enabling them to be more creative, provide more individualized education, and keep students engaged—and research backs this up. Teachers who use AI tools save an average of 5.9 hours per week, which equates to about six weeks per school year. It's also allowing educators to reach more students even with tight financial constraints. For example, Now Go Build CTO Fellow from NextGenU created culturally adapted textbooks at 1/100th traditional cost, scaling from 12 lessons to 605 lessons in 18 months, work that would traditionally require teams of educators working for years. This wasn't possible five years ago.

In 2026 and beyond, personalized AI tutoring will be as ubiquitous as smartphones. Every student will have access to instructions adapted to their learning style, pace, language, and needs. Education is a human system. There are conditions under which people thrive, and conditions under which they don't. Robinson used Death Valley as a metaphor—the hottest, driest place in America where nothing grows. Until 2004, when it rained. In spring 2005, the entire valley floor was carpeted in flowers. Death Valley wasn't dead. It was dormant, waiting for the right conditions.

When you use tools to engage curiosity instead of enforcing compliance, when you honor diversity instead of demanding conformity, schools spring to life. And that changes everything.



Find more predictions

allthingsdistributed.com ›