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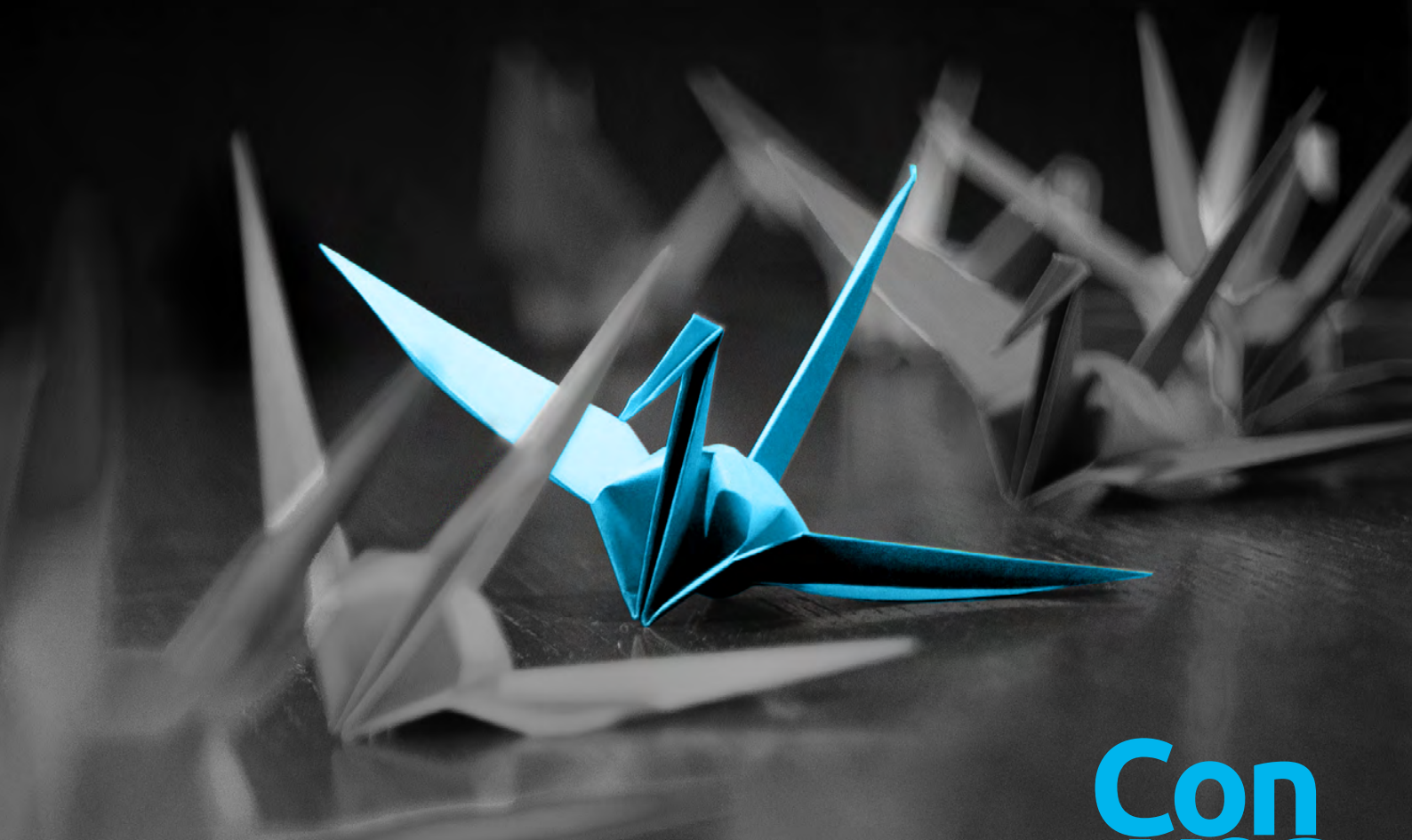
Leaders' perspectives on technology



Conversations FOR TOMORROW

N°10 — 2025

Conversations FOR TOMORROW

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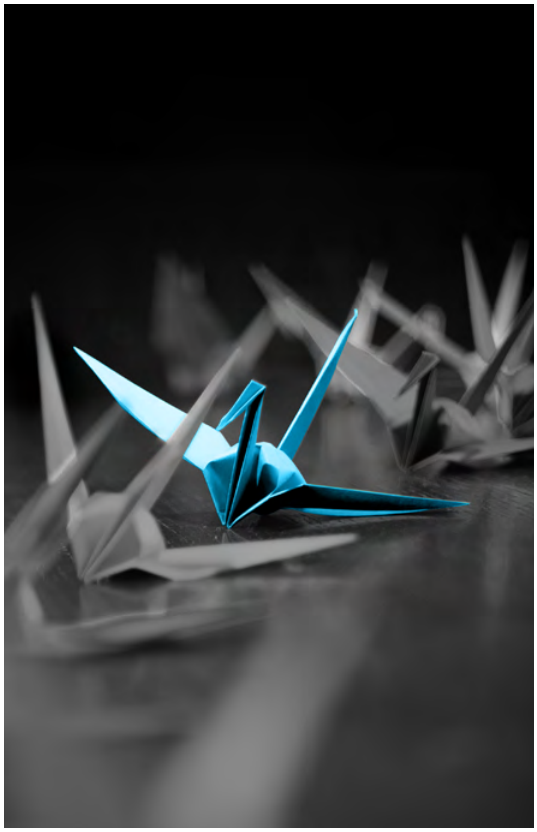
Quarterly review



Technology in motion, patterns in flux. The cover of this edition captures the convergence of breakthrough innovations illuminating the complex patterns shaping our future. It reflects both the promise and the responsibility that come with navigating this rapidly evolving landscape.

Foreword

In this tenth edition of Conversations for Tomorrow curated by the Capgemini Research Institute, we examine the technology trends defining the enterprise landscape for 2025 and beyond. From generative (Gen AI) and agentic AI to post-quantum cryptography (PQC), to software-defined everything and the rise of AI-native organizations, we are witnessing a seismic shift in how organizations conceive, build, and embed technology into the fabric of business.

We explore the following key topics:

- Using AI agents to drive business value
- The rise of physical AI and robotics
- The implications of new technologies for the public sector
- How software-driven mobility is transforming the automotive industry
- Creativity in the age of AI
- When AI meets cybersecurity

The current edition also features two deep dives into emerging technology imperatives from the Capgemini Research Institute.

The first explores how agentic AI, integrated with data and software solutions and platforms, and collaborating seamlessly with humans, drives the creation of new outcomes and client value. Our research shows that organizations expect that, within three years, AI agents will operate as integrated members of human-supervised teams.

Adoption is already underway, but trust remains a critical barrier. Only 27% of organizations express confidence in fully autonomous agents, down from 43% in 2024. Nevertheless, we predict that, with carefully calibrated human involvement, considered ethical design, and robust data foundations, we can unlock as much as $450 billion in economic value from AI agents by 2028.

Our second deep dive focuses on PQC. Organizations are preparing for 'Q-Day,' the hypothetical stage in the development of quantum computers when they will be capable of breaking through today's encryption standards. Although around 70% of early adopters are currently working on quantum-safe solutions, we consider only 15% to be ready across both organizational and technical foundations. Organizations across industries must build quantum resilience, from crypto-agility and protection of legacy systems to talent development and supply chain collaboration.

To keep pace with this transformation, leaders are reimagining their operating models, product strategies, and approaches to talent recruitment and retention. We examine the impact of these technological shifts on a wide range of stakeholders, including leaders, employees, organizations, governments, and the general public. We do this by further amplifying the voices of an illustrious group of contributors who have enriched this edition with their insights:

- Aiman Ezzat, CEO, Capgemini
- Christel Heydemann, CEO, Orange
- Mike Crisafulli, SVP and CIO, Comcast
- Kevin Scott, CTO and EVP of AI, Microsoft
- Walter Sun, SVP and Head of AI, SAP
- Professor Daniela Rus, Director, CSAIL, MIT
- Professor Jeremy Utley, Adjunct Professor, Stanford University
- Annika Ölme, CTO and SVP, SKF
- Corence Klop, CISO, Rabobank
- David Knott, CTO, UK Government
- Yves Caseau, CDIO, Michelin
- Michele Mosca, CEO, evolutionQ
- Pascal Brier, Group Chief Innovation Officer, Capgemini

Collectively, these insights paint a picture of a world where technology is more than a tool for efficiency. It is also a catalyst for creativity, inclusion, and the generation of long-term value.

We hope you enjoy reading this edition as much as we enjoyed putting it together for you.

Franck Greverie
Chief Technology & Portfolio Officer, Head of Global Business Lines
Capgemini

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Executive Summary

The tenth edition of Conversations for Tomorrow is published at a pivotal moment for enterprise technology and society. As organizations navigate the accelerating pace of innovation, they are actively rearchitecting their foundations. This edition explores the defining trends of 2025 and beyond, from agentic AI and post-quantum cryptography to software-defined mobility, robotics, and the evolving relationship between humans and machines.

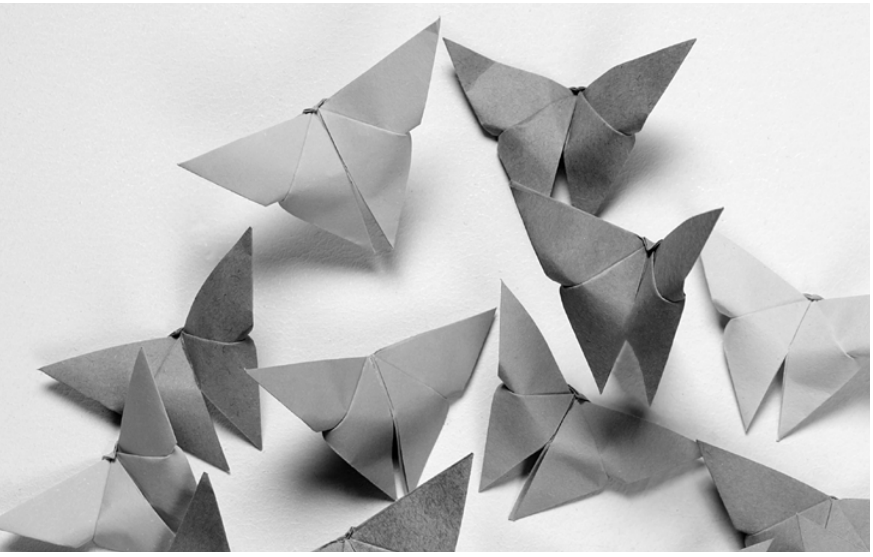
AI goes Agentic

AI is no longer just a tool for automation. Rather, it has become a collaborator, capable of reasoning, planning, and acting with autonomy.

As Aiman Ezzat, CEO of Capgemini, notes: **"Agentic AI represents a new frontier – accelerating efficiency and value creation by automating highly variable processes that traditional technologies cannot automate."** But currently, only 27% of organizations trust fully autonomous agents, down from 43% in 2024. This underscores the need for robust governance and human oversight. Christel Heydemann, CEO of Orange, adds a further note of caution: **"Scaling AI isn't just a matter of installing some software. It can mean rethinking entire workflows that have been in place for years."**

> **"Agentic AI represents a new frontier – accelerating efficiency and value creation by automating highly variable processes that traditional technologies cannot automate"**
>
> **Aiman Ezzat,**
> CEO, Capgemini

Yet, the potential for economic gain is immense. Our research estimates that AI agents could generate $450 billion in value by 2028, driven by productivity gains, reduced cycle times, and accelerated innovation. But to realize this, organizations must balance autonomy with human oversight. "Our job is to audit the auditor," says Mike Crisafulli, SVP and CIO, Connectivity & Platforms, Comcast. **"We'll need robust traceability of exactly what the AI did, what decisions it made, and why."**



> **Scaling AI isn't just a matter of installing some software. It can mean rethinking entire workflows that have been in place for years."**
>
> **Christel Heydemann,**
> CEO of Orange

Walter Sun, Head of AI at SAP, adds a critical perspective on the enterprise journey: **"Multi-agent AI systems enable different AI agents to collaborate and execute complex workflows… What once required extensive human coordination now happens within minutes."**

> **Multi-agent AI systems enable different AI agents to collaborate and execute complex workflows… What once required extensive human coordination now happens within minutes"**
>
> **Dr. Walter Sun**
> Head of AI, SAP

AI gets real in Software Engineering

Generative AI is revolutionizing software development. Comcast's internal rollout of a Gen AI-powered software development lifecycle has already transformed how 700 engineers work. **"They're now interacting with AI tools that can generate code snippets, create test cases, draft user stories from plain English requirements, perform impact analysis, and so on,"** says Crisafulli. Kevin Scott, CTO of Microsoft, echoes this sentiment: **"AI tools offer the possibility of making software engineering less zero-sum. We have a group of researchers whose mission is to eliminate technical debt at scale using AI tools."** But this transformation is not just technical—it's cultural. **"Introducing AI isn't just a technical exercise. It changes how people do their jobs,"** Crisafulli adds.

> **Introducing AI isn't just a technical exercise. It changes how people do their jobs"**

Mike Crisafulli
SVP and CIO, Connectivity & Platforms, Comcast

Post-Quantum Cryptography: Preparing for Q-Day

Quantum computing is no longer a distant possibility. The hypothetical "Q-Day," when quantum machines could break today's encryption standards, is expected by many early adopters to arrive within the next decade. Yet only 15% of organizations are truly ready across both organizational and technical foundations.

> **The quantum threat isn't far off in the future—it's already affecting organizations today"**

Michele Mosca
CEO, evolutionQ

Michele Mosca, CEO of evolutionQ, warns: **"The quantum threat isn't far off in the future—it's already affecting organizations today."** The "harvest now, decrypt later" risk means sensitive data could be compromised as soon as quantum machines mature. David Knott, CTO of the UK Government, underscores the urgency: **"We're now looking at a 10-year horizon for post-quantum readiness… It's not just a technical shift. It's a capability-building challenge."** Corence Klop, CISO at Rabobank, adds: **"Post-quantum cryptography might not be an imminent risk, but we know it's coming. That means**

starting with an inventory of what we currently have, building internal expertise, and embedding these topics in the organization's agenda."

Software and AI meets Robotics

Across industries, software is becoming the backbone of innovation. Yves Caseau, Chief Digital and Information Officer, Michelin describes the shift happening in the automotive industry, **"The overall trend is obvious and unstoppable: cars are becoming computers with added features."** Annika Ölme of SKF highlights how AI and digital twins are transforming manufacturing for efficiency and sustainability: **"We use AI to optimize inventory levels, enhance logistics, and implement smart manufacturing processes… We're also exploring techniques like synthetic data generation to augment our existing datasets and improve the robustness of our AI models."** Daniela Rus, Director of MIT's Computer Science and Artificial Intelligence Laboratory, brings the robotics perspective: **"We're entering a phase where robotics will move far beyond structured factory floors. Robots will learn from human behavior, understand social and environmental cues, and adjust their assistance accordingly… The key is building systems that are trustworthy, interpretable, and adaptable, so humans can rely on them, understand their limitations, and work alongside them with confidence."**

Cybersecurity and Trust in an AI-Driven World

> **"The attack maturity is increasing, which has massive operational implications"**
>
> **Corence Klop**
> CISO, Rabobank

As AI becomes embedded in operations, the threat landscape evolves. Corence Klop, CISO at Rabobank, notes the rise of deepfake threats and AI-powered phishing: **"The attack maturity is increasing, which has massive operational implications."** Organizations are responding by building in-house AI models for detection and response, but the challenge of trust, transparency, and explainability remains. AI is also becoming a key part of the solution. Rabobank is building its own machine learning models trained on internal data to improve detection and response. **"We control the dataset, which means we can fine-tune the model to our environment and threat landscape," Klop explains. "It allows us to embed domain knowledge directly into the model."**

The Human-AI Partnership: Creativity, Leadership, and Inclusion

AI is not just a tool. It's increasingly a teammate. Stanford's Jeremy Utley argues, **"If you want to work with an LLM, treat it like you would treat a new team member."** The future belongs to organizations that foster "human-AI chemistry," blending human ingenuity with machine intelligence. Kevin Scott adds, **"Technology, including software and AI, is a tool that we shape and decide how to use. Unlike past innovations like the printing press or steam engine, today's tools are far more accessible."**

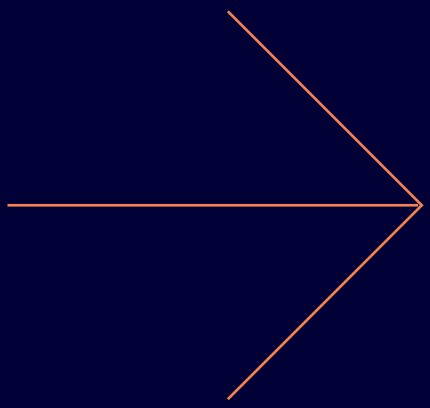
Daniela Rus (MIT) further notes: **"Collaboration is about designing systems that respond to human intent, complement human strengths, and adapt to real-world complexity... In the long term, I envision teams of humans and robots learning together, each bringing unique capabilities: humans with creativity and judgment, robots with endurance, precision, and data-driven insight. The result will be collaborative intelligence, where together, people and robots will be able to do more than people alone or robots alone."**

Convergence is the name of the game

As technology matures, the frontier of innovation is shifting from isolated breakthroughs to the orchestration of converging systems. Pascal Brier, Group Chief Innovation Officer at Capgemini, argues that **"we have entered an era where innovation no longer happens within technologies, but between them. AI learns to reason, robots to collaborate, and energy systems to think."** Technology is no longer just a support function - it is the primary engine of transformation. Across every industry, leaders are rethinking how they build, govern, and scale innovation. As Mike Crisafulli puts it, **"Reimagine, don't just replicate. Invest in your people and change management, and stay laser-focused on the outcomes you want. It's a daunting, but truly exciting time."** This edition of Conversations for Tomorrow captures the voices of those leading this charge - those who see technology not just as a tool for efficiency, but as a catalyst for creativity, inclusion, resilience, and long-term value.

Collaboration is about designing systems that respond to human intent, complement human strengths, and adapt to real-world complexity"

Daniela Rus
Director, Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT



Christel Heydemann
CEO
Orange Group

The CEO Corner

in discussion with

Aiman Ezzat
CEO
Capgemini

Capgemini

Conversations FOR TOMORROW

The CEO Corner

Christel Heydemann
CEO, Orange Group

Christel began her career in 1999 at Alcatel, where she held various management positions. In 2011, she was promoted to Director of Human Resources and Transformation and member of the Executive Committee.

Christel Heydemann joined Schneider Electric in 2014. In 2017, she became Executive Director France Operations of Schneider Electric and member of Schneider Electric's Executive Committee. In 2021, she was named Director Europe Operations, a position she held until the beginning of 2022 when she became Chief Executive Officer of the Orange Group, having served as a member of its Board of Directors since 2017.

She is a graduate of École Polytechnique and École Nationale des Ponts et Chaussées. Christel is an Officer of the French Order of Merit and a Knight of the French Legion of Honor.

Aiman Ezzat
CEO, Capgemini

With more than 20 years' experience at Capgemini, Aiman Ezzat has a deep knowledge of the Group's main businesses. He has worked in many countries, notably the UK and the US, where he lived for more than 15 years.

Aiman was appointed CEO in May 2020. Prior to that, from 2018 to 2020, he served as the Group's COO and, from 2012 to 2018, as CFO. Aiman is also on the Board of Directors of Air Liquide and is a member of the Business Council and the European Round Table (ERT) for Industry. Aiman is a Knight of the Legion of Honor.

Emerging Tech and AI

Which emerging technology trends are you most excited about?

— Christel: Quantum technologies are extremely exciting, especially when it comes to cybersecurity. For example, using quantum key distribution [QKD] to better protect data. But the technology that excites me the most is AI.
AI isn't new, but the speed at which it's evolving – especially when combined with advances such as quantum computing – makes it truly disruptive. I'm particularly excited about how AI could accelerate progress in other fields of science, from physics to drug discovery and healthcare. In fact, I don't think there's a single area of research that AI won't accelerate. Rather than just adding complexity to an already complex world, AI could help us solve humanity's big challenges.

> "AI could help us solve humanity's big challenges"
>
> Christel Heydemann

— Aiman: Generative AI [Gen AI] and agentic AI are at the forefront. AI is evolving from copilots to autonomous, reasoning agents capable of orchestrating complex tasks across supply chains, predictive maintenance, and customer engagement. This shift will enable new AI ecosystems that drive efficiency, resilience, and innovation at scale.

> "Next-gen robots can handle complex, interconnected tasks, improve decision-making, and enhance operational efficiency across industries"
>
> Aiman Ezzat

Second, large language models (LLMs) are transforming robotic capabilities to near-human levels and surpassing human capabilities in some tasks. Next-gen robots can handle complex, interconnected tasks, improve decision-making, and enhance operational efficiency across industries.

Third, there's growing interest in sustainability-focused innovation. AI is not only transforming industries but also driving the resurgence of clean energy sources, such as nuclear, to meet the growing demands of digital technologies.

Where do you see AI and, in particular, Gen AI having the biggest impact?

— Aiman: Agentic AI represents a new frontier of digital transformation, accelerating efficiency and value creation by automating highly variable processes that traditional technologies cannot automate. I believe AI agents can transform the way in which businesses operate. Successful enterprise operations require AI agents working seamlessly with humans, under human control. I like to call this human-AI chemistry. We see Gen AI assistants and AI agents as tools to assist people (such as coding assistants) by augmenting and amplifying human ingenuity (for example, in developing new molecules). Most professions will be affected by AI one way or another and, whatever their seniority, they should learn how to use these tools. This should be a massive change-management priority for business leaders.

In the short term, the most promising fields are business process operations with agentic AI workers for hyper-automated operations 24/7; go-to-market, with enhanced customer targeting, experiences, and interactions; IT, as in software development with coding assistants and agents; testing automation; knowledge management, such as creating documentation, etc.; and in the delivery of greater value in terms of CX and new products delivered faster and better, including with improved R&D (such as developing new molecules or lighter parts in automotive/aerospace).

— Christel: AI has already had a huge impact at consumer level. Interestingly, a lot of that usage today is for fairly simple things, like getting answers or summaries quickly.

In the professional world, one of the biggest impacts we see right now is in software development. AI coding assistants are speeding up programming, and that affects many tech companies. At Orange, it's also changing how we work by bringing a lot of efficiency in-house. AI makes a difference in almost every routine process, from automating fraud detection in banking to streamlining compliance checks. In the telecom sector specifically, we're working on what you might call AI-driven or "intent-driven" networks. We're also applying AI to improve customer service. Gen AI offers more personalized self-service tools, smarter chatbots, and so on, which ultimately raise customer satisfaction.

I also see great potential for AI to be used as a personal coach or assistant for employees. Think of an AI mentor that helps you learn new skills or navigate challenges at work, at your own pace. Today, if you want to upskill, you might take a course or ask a manager – and sometimes people feel shy or judged in those situations. But an AI tool is completely non-judgmental. It's just there to help you whenever you need it. I believe using AI in that way – to empower employees in their own development – could be very impactful.

> **"I also see great potential for AI to be used as a personal coach or assistant for employees"**
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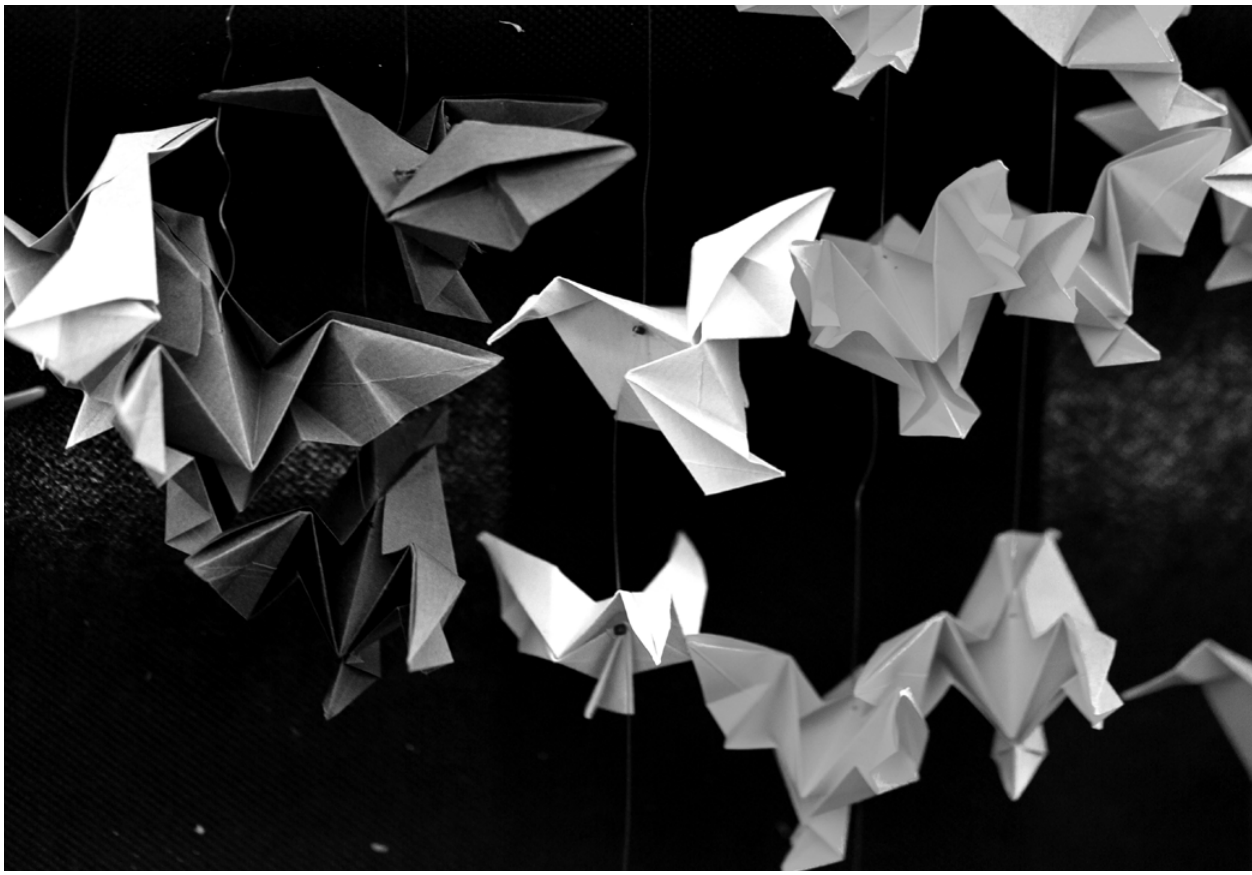
> Christel Heydemann



What do you think is the biggest hurdle to scaling AI?

— Aiman: It's not the technology. It's trust, governance, and organizational readiness.

While most organizations have moved beyond pilots, only 9% have successfully deployed Gen AI across multiple functions/locations. This highlights the challenge in operationalization, rather than experimentation. Capgemini research shows that the portion of organizations that trust in fully autonomous AI agents has declined from 43% to

> **"The portion of organizations that trust in fully autonomous AI agents has declined from 43% to 27% in the past year"**
>
> Aiman Ezzat

> **"Scaling AI is less about algorithms and more about building trust, governance, and a culture ready for hybrid human-AI teams"**
>
> Aiman Ezzat

27% in the past year, and many have yet to put in place robust governance frameworks. This lack of trust and governance slows adoption and creates risk.

The data foundation is also critical. AI-at-scale leaders rank improving data quality and accessibility as the number-one enabler of success. Without strong data governance, hybrid cloud architectures, and democratized access, AI initiatives remain siloed and fail to deliver enterprise-wide impact.

Finally, human-AI collaboration and cultural transformation are often underestimated. In the short to medium term organizations will have AI agents working within human teams. Blended teams – where humans and AI agents collaborate – will become the norm, driving productivity and innovation. Reskilling, new operating models, and fostering "human-AI chemistry" are essential to sustainable, trusted AI adoption.

In short, scaling AI is less about algorithms and more about building trust, governance, and a culture ready for hybrid human-AI teams.

— Christel: Anyone can play with ChatGPT and get it to draft an email or summarize a document. Those use cases are relatively straightforward and can bring quick wins. And as long as you put data safeguards in place, rolling out those basic tools to employees isn't too difficult.

But if you want AI to fundamentally reinvent processes, that's a much bigger challenge. You need well-organized, accessible data. You might have to re-engineer processes to integrate AI effectively. Often, you even have to change the culture of the organization, so that people trust the AI enough to use it in their daily decisions. Scaling AI isn't just a matter of installing some software. It means rethinking entire workflows that have been in place for years. That kind of change doesn't happen overnight.

"It means rethinking entire workflows that have been in place for years"

Christel Heydemann

Telecoms and AI

What impact do you think AI will have on telecom networks, and what does an AI-driven network look like?

— Christel: AI will have a massive impact on telecom networks, both in how they're used and how they're run. From an infrastructure point of view, AI applications are going to generate huge amounts of data traffic. Whether the AI is running in the cloud or out at the edge (in a factory or on a smartphone, say), it needs to send data back and forth. That means networks will carry a lot more data, and different kinds of data, than they do today. We anticipate that, by 2030, around two-thirds of all network traffic could be related to AI in some way. When you think about it, that's enormous.

> "We anticipate that, by 2030, around two-thirds of all network traffic could be related to AI in some way"
>
> Christel Heydemann

AI-driven traffic will have different patterns and requirements. If you look at the history of networks, 20–30 years ago, most traffic was voice calls. Then the internet brought a surge in data traffic. More recently, video streaming exploded, which meant our networks had to handle a ton of data going from the network to users. Telecom operators responded by building content delivery networks and beefing up capacity to make video streaming smooth. Now, with AI, we expect a lot more upstream traffic (devices and sensors sending data to the cloud for processing, or users uploading content for AI to analyze). Some AI applications will also demand low latency. For instance, if you have an AI-driven control system in a factory, it needs real-time responsiveness.

Our current network architectures are designed mostly for heavy downloading (video, web browsing, etc.). We'll likely need to re-engineer parts of the network to cater to this new AI-driven pattern . Technologies such as 5G (and, eventually, 6G) are already pushing in this direction. They allow more flexible routing of data and edge computing, which brings some processing closer to the user to reduce latency. In an AI-driven network, you'd see a lot more intelligent routing of data: "Send this data to a cloud server for heavy processing" or "Handle this request right at the edge node, near the customer, because it's latency-sensitive."

On the operations side, AI is going to be indispensable for managing and securing complex networks. Keeping everything running optimally is a huge task. AI can help by analyzing vast amounts of network data in real time and adjusting or flagging issues. For example, an AI system could predict that a certain network node will become congested in the next five minutes and proactively reroute traffic, or it could detect a hardware fault and alert us to fix it before it causes an outage. AI can also filter out the noise. In network operations centers, we get thousands of alerts, and many are false alarms. AI can learn to tell the difference and only raise the truly important issues.

> "With AI, we expect a lot more upstream traffic"
>
> Christel Heydemann

In cybersecurity, AI is a tool for both attackers and defenders. We're using AI to strengthen our defenses: detecting unusual patterns of network traffic that might indicate an attack or identifying malware. But we know attackers are also using AI to find new vulnerabilities or to automate attacks. So, it becomes a bit of an arms race. An AI-driven network will likely include AI "guardians" that continuously monitor and protect it. Manual monitoring just can't keep up with the speed of attacks nowadays.

> "We'll likely need to re-engineer parts of the network to cater to this new AI-driven pattern"
>
> Christel Heydemann

— Aiman: AI will fundamentally transform telecom networks by making them autonomous, predictive, and service-centric. Tomorrow's AI-driven networks will be self-configuring, self-healing, and self-optimizing, enabling telcos to deliver superior performance and new revenue streams.
AI will integrate deeply into network operations, enabling real-time anomaly detection, predictive maintenance, and proactive issue resolution.

Gen AI is already revolutionizing network operations by providing intelligent document querying, automated troubleshooting, and conversational interfaces for technicians, reducing downtime and improving resilience. Agentic AI will unify customer service and network operations, creating end-to-end automation that eliminates silos and accelerates problem resolution, while reducing costs and penalties.

How do you see the future of the telecom sector, and what role will software play?

— Christel: The telecom sector is at a crossroads. On one hand, telecom has been the backbone of huge technological shifts – for example, the shift to mass cellphone use. Our networks were (and are) the foundation that made innovations like smartphones useful. Most of the time, though, people don't even think about the network until something goes wrong with it. Then, we realize how central it is to modern life. Also, if there's a natural disaster (floods, wildfires, storms) or a major cyber incident, people rely on telecom networks to contact loved ones and get help. It's a responsibility we take very seriously.

On the other hand, another big question for the future of telecom is economic: how do we capture more value from the digital economy? Over the past couple of decades, the big tech and internet companies, rather than telcos, have captured a lot of the profit and value from new digital services. That dynamic isn't sustainable over the long term. So, moving forward, telcos are looking to monetize services more effectively. Part of that is working with the big content and tech companies to find fair models. Another is developing our own new services. This is where software comes in, whether it's IoT platforms, cloud services, or AI services, to move up the value chain.

> "How do we capture more value from the digital economy"
>
> Christel Heydemann

> **In Europe we have a very competitive telecom market but, currently, it's too fragmented"**
>
> Christel Heydemann

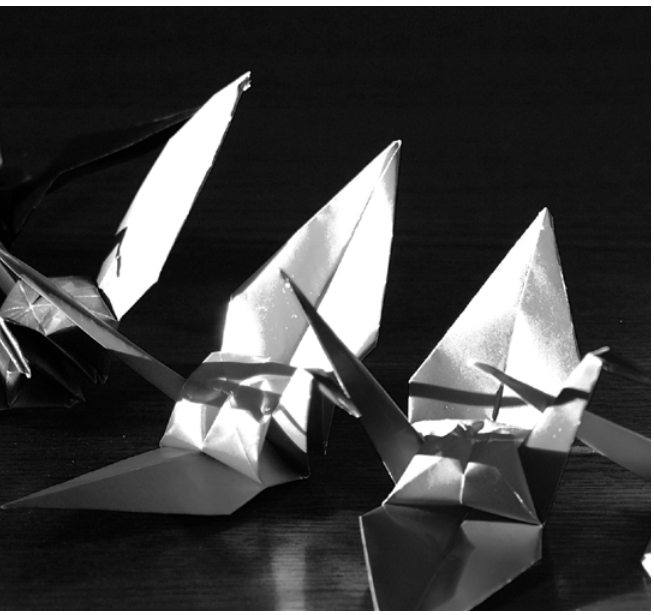
This ties into the question of scale. In Europe we have a very competitive telecom market but, currently, it's too fragmented. For instance, the US and China each have just a handful of large telcos, whereas in each European country you might have three, four, five operators fighting over a relatively small market. This makes it hard to achieve the scale to invest heavily in new technologies and get strong bargaining power with equipment suppliers and phone manufacturers. The European regulatory environment was created about 20 years ago, when the priority was breaking up monopolies and encouraging competition within each country. Back then, that made sense. It brought prices down for consumers and drove adoption. But, despite the market having matured, in 2025 we're operating under largely the same rules. We need to rethink those rules to reflect new realities.

Recently, an EU-commissioned report by [former European Central Bank President] Mario Draghi made this point very clearly: Europe should modernize its telecom regulations and encourage consolidation. I agree with that perspective. Growth is about new services, rather than new customers. In a low-growth environment, having five competitors where two or three would suffice means revenues get spread too thinly. Telecom is a business with high fixed costs. You need a certain scale to be efficient. If we can achieve greater scale (for example, through mergers or partnerships), we can be more efficient and invest more in innovation and network upgrades.

> **Europe should modernize its telecom regulations and encourage consolidation"**
>
> Christel Heydemann

Scale also matters when dealing with global tech giants. A bigger, consolidated European operator would have more sway when negotiating with Apple or Google on things like network features or revenue-sharing models. Right now, if you're a smaller operator, it's hard to influence those discussions.

The networks of the future will still be our core, but we'll develop more software, more services, and more partnerships to ensure we capture a fair share of the value. Providing excellent connectivity is non-negotiable. But we also want to grow beyond connectivity, so we remain competitive and relevant in the digital economy.



> **Leaders everywhere are asking: How do we make sure we don't lose control over our future? Europe has lost ground in many areas of tech over recent decades"**
>
> Christel Heydemann

You've mentioned Europe and sovereignty. Why do you believe consolidation is so important in this context?

— **Christel:** Technological sovereignty is about a region or country maintaining control over its tech destiny. This concern comes up a lot in Europe, as well as Africa and the Middle East. Leaders everywhere are asking: How do we make sure we don't lose control over our future? Europe has lost ground in many areas of tech over recent decades (there's no European equivalent to Google or Apple), so we have to be smart and defend the strong positions we do have, while building new capabilities for the future.

One of Europe's challenges is that, on a global scale, even our biggest companies are relatively small. In telecom, for instance, Orange is the second-largest operator in Europe, which sounds great, but in global terms our size is modest. When we negotiate with giant companies like Apple, Google, or Amazon, a single European operator – or even a single European country – doesn't have a lot of clout. These companies operate across the entire world, with billions of users, meaning they set terms. That's a tough position for us, as European businesses, to be in.

This is where consolidation comes into play. By consolidation, I mean encouraging the formation of larger, stronger European entities (through mergers, alliances, etc.) that can stand toe-to-toe with the global giants. If we had, say, a pan-European telco, instead of many smaller national ones, that larger entity could invest more in new technology, achieve better economies of scale, and have more influence in partnerships or negotiations. The same logic can apply in other tech industries. Size isn't everything, but it does matter when you're competing globally.

The EU has recognized these issues. We've seen new regulations like the Digital Markets Act (DMA) and Digital Services Act (DSA) introduced to curb the dominance of the big global tech platforms. The upcoming AI Act is designed to ensure AI in Europe respects our values. All of these are important steps to protect consumers and competition. However, regulation alone is not enough to guarantee Europe's tech sovereignty. We also need our own champions. That was a key message in the report led by Draghi: Europe must build competitive European firms. Instead of 10 fragmented markets, act as one big market, so our companies can scale up.

Now, specifically in telecom, Europe still has dozens of operators. The US, by comparison, has three big mobile carriers for a similar-sized population. That gives you an idea of how fragmented we are.
Consolidation in telecom could mean better, more efficient networks and a healthier industry that can afford to invest in next-generation technology (such as 6G, or fiber everywhere, etc.). It could also support our sovereignty by ensuring we have European operators with the clout to implement European priorities (such as covering rural areas or building secure networks to European standards).

Sovereignty isn't just about who runs the networks. It's also about who develops and controls AI and the other new technologies that will shape the future. We have amazing car companies, energy companies, pharmaceutical

companies in Europe. If they all embed AI and become more competitive, Europe stays strong. If they hesitate because of lack of resources or fear of the unknown, we risk falling behind not just in tech, but in those industries, too.

We should regulate AI to address risks (privacy, bias, etc.), but we must not over-regulate to the point that we stifle innovation, because other regions will absolutely forge ahead. Europe should aim to lead in areas such as ethical AI, industrial AI, AI at the edge (where we have some advantages with our engineering and manufacturing base). We don't have the dominant social media platforms or the dominant smartphone operating systems, but new battles are coming with AI and other tech. We have to position ourselves to win some of those.

How do you use AI in your day-to-day role as a CEO?

— Aiman: I believe Gen AI can advance beyond simply being a productivity tool to become a co-thinker for managers in organizations of all sizes, aiding in problem-solving and decision-making. It can become a sparring partner, offering fresh perspectives and challenging assumptions, even enhancing strategic thinking and leadership development. It is one of the inputs I take before I make a decision.

— Christel: To be honest, I don't use AI in a very heavy or specialized way day-to-day – at least, not yet. But I do take advantage of some of the tools out there. For example, instead of doing a traditional Google search for information, I might put a question to our internal AI assistant or to a tool like ChatGPT to get a quick, synthesized answer. It often gives me a more concise answer than wading through pages of search results.

The biggest boost I get from AI is in managing information flow. I receive a lot of lengthy documents – reports, presentations, analysis. We have an internal AI-powered tool (it's like our own ChatGPT trained on corporate content) that can generate summaries of these documents. So, if someone sends me a 50-page PowerPoint deck, the AI can produce an executive summary or bullet-point highlights. This has been a game-changer in terms of saving time.

Of course, as a CEO, if it's a critical matter I won't rely solely on the AI summary. But it's a fantastic starting point. If something in the summary catches my eye, I'll jump into that section of the full document to learn more. It's a way of triaging information.

I've also been working to train and educate myself and my executive team on using these tools effectively. We held a workshop where we experimented with writing prompts to get better outputs from AI. We're extending that kind of training throughout the company. This includes understanding their limitations. I enjoy testing the AI and seeing where it might misfire. I'll sometimes deliberately ask it a question to which I know the answer, just to gauge its accuracy. It's a reminder that you still need a critical eye. AI can streamline a lot of things, but you can't 100% outsource your judgment to it.

Another area where AI comes into my work routine is communication. I know some of my team members use AI to draft emails and even brainstorm ideas for presentations. I've tried out Gen AI to see if it can rephrase a complex message more clearly, or to summarize long email threads. I'm not a salesperson, so I'm not using AI to, say, write sales pitches every day, but I know our sales and marketing folks are exploring those applications. For me, it's more about efficiency in reading and research. And I do find it helpful. AI shaves hours off of mundane work for me each week, which is pretty significant. It lets me spend more time on the human aspects of the job that AI can't do, like strategy, mentoring, and so forth.

Women in leadership

How can we break down the barriers to more women reaching senior leadership roles?

— **Christel:** That's a multifaceted challenge that many companies and societies are grappling with. I think the solution lies partly in empowering women themselves, and partly in changing the culture around them.

> **"We often find that women, even extremely talented ones, are less inclined to put themselves forward for promotions or high-profile projects"**
>
> Christel Heydemann

We often find that women, even extremely talented ones, are less inclined to put themselves forward for promotions or high-profile projects. There's a lot of research showing that a woman might feel she needs to meet 100% of the job criteria before applying, whereas a man might only feel he needs to meet 60%. So, one barrier is this confidence gap and a tendency to self-withdraw from opportunities. We can encourage women through mentorship and sponsorship programs, and by creating an environment where they feel their contributions are valued. I always say, the more we showcase strong female role models, the more other women will see a path for themselves. It's inspiring to see someone who has a similar background or faced similar challenges succeed. It makes it seem more achievable for the next person.

On the company side, it starts with a genuine commitment at leadership level. At Orange, we've made it a clear priority to help women progress. That means we set measurable targets (for instance, increasing the percentage of women in top management by a certain amount), and we track progress as we would with our financial metrics. We also have initiatives such as leadership development programs specifically for high-potential women, and training for all employees to address unconscious bias. These efforts signal that we're serious about change. And it requires sustained effort. It's about building an inclusive culture where women have equal access to opportunities and feel valued, personally and professionally.

— Aiman: Breaking down barriers for women to reach senior leadership roles starts with disrupting persistent gender stereotypes. Our research found that, while the vast majority of leaders agree women are as effective as men, stereotypes around future-critical skills such as AI, automation, and data analysis remain deeply entrenched. Nearly half of male executives in our research perceive these technical skills as "masculine." Left unaddressed, this bias could widen the leadership gap.
There's a few things leaders can and should do:

- **Interrupt bias systematically:** Train leaders to spot and challenge bias and make hiring and promotion criteria transparent.
- **Embed technical fluency:** Ensure all leaders, regardless of gender, have access to training in AI and data skills, which are increasingly vital to advancement.
- **Democratize sponsorship and mentorship:** Provide equal access to mentors, sponsors, and high-visibility assignments.
- **Normalize flexibility:** Make flexible work options available to everyone, supporting both women and men in balancing work and life.

Christel Heydemann
CEO, Orange Group

"AI will have a massive impact on telecom networks, both in how they're used and how they're run."

Aiman Ezzat
CEO, Capgemini

"Scaling AI is less about algorithms and more about building trust, governance, and a culture ready for hybrid human-AI teams."

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Microsoft

TURNING SCARCITY INTO ABUNDANCE

Kevin Scott is Microsoft's Chief Technology Officer. Prior to joining Microsoft, he was Senior Vice President of Engineering and Operations at LinkedIn. Earlier in his career, he oversaw mobile ads engineering at Google. He sits on the board of directors of Shopify; advises several Silicon Valley startups; is an emeritus member of the board of trustees of the Anita Borg Institute and a trustee of The Scott Foundation. He is also an active angel investor and founded the nonprofit organization Behind the Tech.

As a tech leader, how have you seen the sector evolve?

The changes have been mind-boggling. I wrote my first program when I was 12 years old, and I just turned 53. The process is very different now. As a software developer, your toolset has become unbelievably powerful over the past four decades and this is reflected in the products that we're developing. And I think we're still accelerating.

We're probably going to have more change over the next 40 years due to technology than in the past 40. It is certainly the case that the capabilities for the tools will continue to increase and it creates this enormous possibility space for society to think about which problems we want to solve. Some people view technology as an unstoppable force, outside our control. While it's true that technology evolves in unexpected ways, I reject the notion that we have little agency over its outcomes. Technology, including software and AI, is a tool that we shape and decide how to use. Unlike past innovations like the printing press or steam engine, today's tools are far more accessible.

Kevin Scott
CTO and EVP of AI
Microsoft

When I left academia for Silicon Valley 22 years ago, my first project was a machine learning [ML] task at Google, automating part of the ad system's backend. Despite my background in low-level systems and programming languages, I had to dive deep into research, spending six months writing complex code. Today, a high school student could complete the same task in a single morning. The democratization of these powerful tools means more people can pursue their interests, and AI is accelerating this trend.

How do you stay ahead of tech trends?

Predicting the future is challenging. Arthur C. Clarke wrote a famous set of essays in the late 1960s called *Profiles of the Future*, in which he suggested three laws. We're all familiar with the third law: "Any sufficiently advanced technology is indistinguishable from magic." However, Clarke also emphasized that we are generally terrible at predicting exactly what the future will look like. But Clarke noticed that, while we often get the details wrong, we can get the contours right if we pay attention.

> **"We're probably going to have more change over the next 40 years due to technology than in the past 40"**

With OpenAI [Microsoft's coding and AI platform, for which Scott led the investment in 2019], I've been watching the ML discipline for a long time. Having run gigantic ML projects, I understood the difficulties. Suddenly, OpenAI had a mechanism that solved some of these big, intractable problems and was scaling. It wasn't just a one-time solution; it solved a whole category of problems, with a path for scaling. Every time we turn the crank, the range of solvable problems increases. Spotting trends like this is crucial for betting on technology. A good team and access to capital are also important investor considerations.

On the flip side, you need to watch the rate of progress. For instance, blockchain excited everyone as a potential solution to many problems. However, the question that wasn't asked was, which problems would it uniquely solve? For example, people were using blockchain inappropriately, as a database or for other gratuitous solutions. It's essential to determine if a new technology solves a set of problems better than available tools. Otherwise, what's the point?

It's incredibly difficult to convince people to adopt something that isn't a real solution to a problem they have. They'll figure it out quickly, and it just won't get used. Over time, it becomes easier for people to make those calls. As a platform builder at Microsoft, we focus on building platforms that are broadly useful, even if we can't imagine all the potential uses at design stage. We need to have a bit of humility and trust the judgment of those adopting our tools to find interesting applications. It's crucial to pay close attention to the utility cycle.

IT'S ESSENTIAL TO DETERMINE IF A NEW TECHNOLOGY SOLVES A SET OF PROBLEMS BETTER THAN AVAILABLE TOOLS. OTHERWISE, WHAT'S THE POINT?

How is AI impacting software development?

The rate of adoption of AI technology is dramatically changing data center infrastructure. I predicted that the demand for AI model inference would become a core aspect of application development. The capital invested in supporting inference is soon going to dwarf other investments.

> **AI tools offer the possibility of making software engineering less zero-sum"**

When there's a big shift in workloads on top of infrastructure, you need to reimagine everything from first principles. This is a common pattern in software development. Initially, you build new emerging technologies on existing infrastructure because there's no other way to bootstrap it. But once it starts taking off, you face a massive optimization problem to purpose-build everything around the new dominant pattern.

The nature of software engineering is changing dramatically. We are using AI to perform increasingly complex software development tasks, which is beneficial even for a company like Microsoft, one of the largest software engineering companies on the planet. Despite our resources, we never have enough engineering capacity to do all the work we need to, turning software development into an excruciating zero-sum game that involves constant trade-offs.

AI tools offer the possibility of making software engineering less zero-sum. For example, inside Microsoft Research, we have a group of researchers whose mission is to eliminate technical debt at scale using AI tools. Technical debt is hard to avoid and accumulates like real debt, with interest payments that must be addressed, or else it can lead to significant trouble. Using AI to tackle technical debt is transformative and changes the dynamics of running an engineering organization.

What are your views on agentic AI?

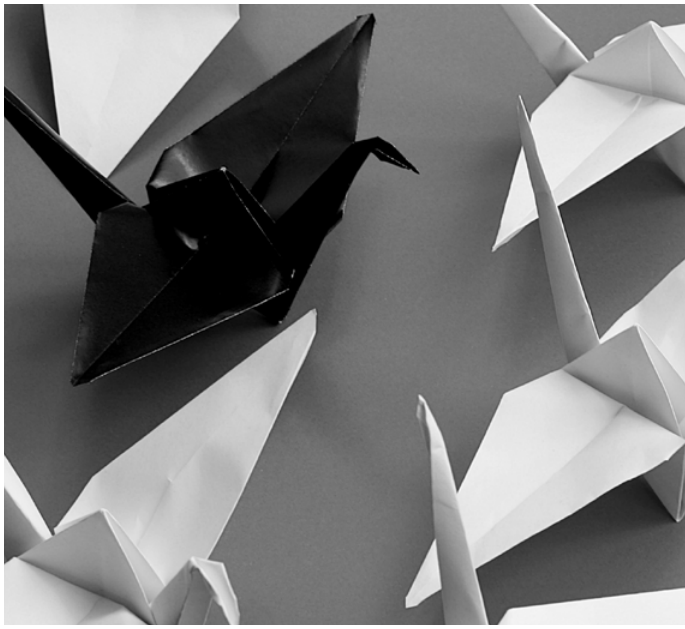
It's exciting. At the highest level, the thing I've been hoping for my entire life is about to happen. Since Ada Lovelace wrote her first program 200 years ago, if you want to access technology, you have needed to either be a programmer, with an understanding of machine complexity and translating human problems into machine-solvable forms, or depending on programmers to anticipate needs and package code into applications.

"We are using AI to perform increasingly complex software development tasks"

With agentic software, this paradigm is breaking. Soon, software engineering and product management won't involve conceiving and packaging applications or services and then running experiments to see if they got it right. Instead, an agent will be able to translate your needs with high fidelity and execute them. The capabilities in these apps will need to be actuatable by your agent, leading to a profound change in how software is produced and used.

Sam Altman [CEO of OpenAI] has said that first-generation agents, like those in the GPT-4 era, were good at completing five-second tasks. The current generation handles five-minute tasks and, over time, agents will be capable of longer and more complex tasks. For example, my daughter, a 10th grader doing an internship at Stanford, asked me how convolutional neural networks [CNNs] work. She was trying to build a blood oxygen saturation monitor using retinal images and needed to segment the blood vessels. I immediately thought about challenges such as insufficient data to train a CNN model. However, using deep research [an OpenAI research agent] and ChatGPT on my cell phone, I provided her with 24 citations, including medical literature, image processing algorithms, and the right open-source library. It even wrote the Python code for segmentation. What would have taken me two days in grad school was compressed into five minutes. That's where we're headed. This illustrates the growing complexity and capability of AI agents.

"Using AI to tackle technical debt is transformative and changes the dynamics of running an engineering organization"

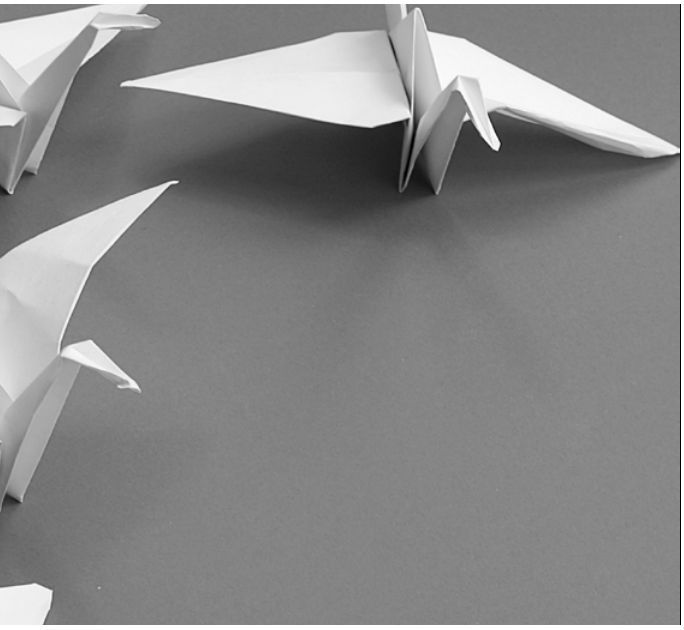


How should large organizations and employees adapt to agentic AI?

Everyone should read [LinkedIn founders, Reid Hoffman and Greg Beato's] new book, Superagency. I strongly agree with their point that the most successful employees in the future will be early and ambitious adopters of AI tools. Some people have already figured out how to be more productive by using systems to handle the most irritating parts of their jobs, freeing them up to do what they are uniquely good at. These individuals are getting hold of the tools they want and it's having a real positive impact on their productivity.

While there will be some disruption, the most successful businesses will hire great people and equip them with the best AI tools. The idea of winning purely through cost optimization by substituting human labor for AI, without reinvesting savings in the human workforce to create innovation and value, is unlikely to work. Over time, the markets will reflect this, and we will see lots of investment in people.

As much as I am a fan of AI, there are plenty of things it will likely never be good at. There is also a strong human preference for interacting and working with other humans, which isn't going to change.



"The idea of winning purely through cost optimization by substituting human labor for AI, without reinvesting savings in the human workforce to create innovation and value, is unlikely to work"

How do we ensure AI benefits everyone?

People genuinely want to help others. I already see many people using these tools for good. Society should focus on addressing the most challenging problems we face. Often, the friction and irritation in society stem from zero-sum games, like healthcare. We have a finite capacity to deliver healthcare to a population whose demands are growing due to demographic aging. In this context, technological disruption is necessary to avoid a crisis.

Policymakers and those thinking about incentive structures should look to AI to open zero-sum areas so that there are more winners. Everyone wants high-quality, efficiently supplied healthcare that is both abundant and cheap, and AI can help us achieve that. It can also help address other challenging issues such as the need for sustainable energy, climate change, access to education, and more. There are plenty of areas where technology can turn scarcity into abundance.

"Policymakers and those thinking about incentive structures should look to AI to open zero-sum areas so that there are more winners"

Kevin Scott
CTO and EVP of AI
Microsoft

"There are plenty of areas where technology can turn scarcity into abundance"

ANNIKA ÖLME

Chief Technology Officer

SKF Group

USING TECH TO REDUCE FRICTION

Annika Ölme is Chief Technology Officer and Senior Vice-President Technology Development for the SKF Group. Annika is responsible for research, Technology Development, product development, and technology strategy globally. She is a member of group management at SKF; a board member at Denmark-based GRUNDFOS, the largest pump manufacturer in the world; and Chair of the Jacob Wallenberg Foundation, which supports research in material science. In 2024 Fortune named Annika as one of Europe's 20 most influential Women in Tech. She is based in Gothenburg, Sweden.

Can you help us give an overview of SKF?

Founded in 1907, SKF is a world-leading provider of innovative solutions that help industries become more competitive and sustainable. Reducing friction is the core of what we do. Our offering around the rotating shaft includes bearings, seals, lubrication management, condition monitoring, and services. By making products lighter, more efficient, more durable, and more easily repaired, we help our customers improve their rotating equipment performance and reduce their environmental impact. We operate in around 40 different industries across 130 countries, ranging from wind power and gearboxes to pulp and paper and metals. Increasingly, we focus on intelligent solutions that combine our expertise in rotating equipment with data and AI to predict and prevent failures, improving both performance and sustainability.

Annika Ölme
Chief Technology Officer
SKF Group

As CTO, what is your role in transforming SKF with technology?

As CTO, my role includes defining and delivering the overall technology strategy and our digital transformation. We want to reimagine rotation for a better tomorrow, and this is intertwined with our 'intelligent and clean' strategy. Apart from resolving our customers' issues, and continuing to grow our capabilities, I spend a lot of my time on building a tech-fueled future that will set us apart from the competition. A key aspect of my role is fostering a culture of innovation and collaboration, both internally and with external partners.

SKF AND EMERGING TECH

When it comes to emerging technologies, what do you see are the top technologies that organizations should watch out for?

Clearly, technological disruptions, climate change, and economic instability are shaping the business environment in 2025. From a technological standpoint, four trends stand out. First, organizations will continue to focus on digitalization to drive operational efficiency and transform the customer experience. Second, AI continues to be front and center, with organizations looking beyond high-risk 'moonshot' projects to more pragmatic, scalable applications, underpinned by robust AI infrastructure.

"AI continues to be front and center, with organizations looking beyond high-risk 'moonshot' projects to more pragmatic, scalable applications, underpinned by robust AI infrastructure"

Within this AI landscape, quantum-inspired techniques, while still nascent, hold promise for long-term advanced simulations and optimization. Finally, sustainability remains a defining driver of business strategy, as clients increasingly demand energy-efficient, circular solutions that reduce environmental impact. Taken together, these trends emphasize the need for a flexible innovation strategy to help companies remain competitive in a rapidly shifting landscape. Let me expand on some of the key technology trends.

QUANTUM-INSPIRED TECHNIQUES, WHILE STILL NASCENT, HOLD PROMISE FOR LONG-TERM ADVANCED SIMULATIONS AND OPTIMIZATION

Artificial intelligence and Generative AI

Artificial intelligence (AI) is transforming our daily lives. Generative AI (Gen AI) is becoming an essential tool for organizations looking to thrive in an increasingly complex and fast-paced world. In 2025, organizations will focus more on adopting and integrating AI-enabled technology into their operations, as well as intensifying training to develop AI-ready employees. With technology touching so many different parts of the business, a clear understanding of the evolving AI landscape – including robust AI infrastructure – will be the key for organizations to explore its full potential and identify new revenue sources.

Transition to smart manufacturing

Advancements in Industry 4.0 technologies, the Industrial Internet of Things (IIoT), and continued progress in faster computing power will accelerate the shift towards smart manufacturing. This means more AI, better data governance, and an intensified focus on security, offering advantages in terms of optimizing production schedules, reducing downtime, and driving operational efficiencies. Such benefits resonate strongly across manufacturing and industrial sectors.

Cleaner data will be the new gold standard.

Today, organizations use data insights in near real time to improve operational and financial performance and gain a competitive edge. The path to smart manufacturing begins with harvesting high-quality, accurate, and reliable real-time data from a wide range of IoT devices for quick processing. Organizations must prioritize data quality and invest in robust data management practices to drive growth and improve digital customer experiences, further underlining the need for secure, well-managed data pipelines.

> **Organizations must prioritize data quality and invest in robust data management practices to drive growth"**

> **Increasing regulatory pressure and greater customer awareness keep sustainability at the forefront of corporate agendas in 2025"**

Sustainability front and center

Increasing **regulatory pressure and** greater **customer awareness** keep sustainability at the forefront of corporate agendas in 2025. Customers will look for partners who can implement technologies that support progress toward their net-zero and sustainability goals. Organizations that prioritize energy-efficient products and circular business models – emphasizing resource reuse and recycling – are more likely to gain a competitive advantage, while focusing on value creation.

"Organizations that prioritize energy-efficient products and circular business models – emphasizing resource reuse and recycling – are more likely to gain a competitive advantage, while focusing on value creation"

What is the role of startups and academia in your technology strategy?

While we maintain robust in-house R&D capabilities, **collaborations with startups and academic** institutions are critical to expanding our innovation pipeline. Universities provide specialized expertise in areas such as **advanced materials research, sensor technologies**, and data analytics, enabling us to explore cutting-edge solutions that complement our own development work. By partnering with these academic teams, often through joint research projects, we can refine product performance, gain deeper insights into emerging trends, and accelerate the **proof-of-concept** (PoC) stage for new applications.

Similarly, startups play a crucial role, particularly outside our traditional core areas. Through targeted programs and alliances, we gain early access to **disruptive technologies** and innovative business models, allowing us to test and scale new solutions rapidly. This not only **broadens** our perspective on emerging markets but also enables faster growth in fields where agility and external expertise are paramount. Collectively, these partnerships with **startups and academia** ensure our technology strategy remains innovative, adaptable, and closely aligned with evolving industry demands.

How is SKF using AI and Gen AI at SKF?

At SKF, we use AI and Gen AI to enhance both our digital products and tools for the customer and improve operational efficiency across various domains. Our initiatives include the development of AI-driven tools for predictive maintenance, quality control, and customer service automation where we do our own development. We also work with our suppliers and partners to integrate Gen AI into our digital workplace with the launch of the Github copilot for software developers and Microsoft Copilot for specific areas of the business, which helps streamline workflows and improve productivity. Additionally, we have implemented vision-based solutions to identify bearing failure modes, which assist our customers and application engineers in making better decisions for remanufacturing opportunities and striving toward our sustainability goals.

> **"Our initiatives include the development of AI-driven tools for predictive maintenance, quality control, and customer service automation"**

How has your recently launched Gen AI-enabled product assistant been received?

The early response to our Gen AI-enabled product assistant has been positive. The SKF Product assistant, which uses large language models (LLMs) and our extensive proprietary product data, has been well-received by users for its ability to provide accurate, reliable answers. However, we know that Gen AI will be a supporting tool, rather than the one and only answer to our engineering questions. The main challenge now is to support our users in writing questions (as opposed to the key word search model) to see what full capability looks like. We are also adding more data into the solution to cover our full product offering.

THE SKF PRODUCT ASSISTANT, WHICH USES LARGE LANGUAGE MODELS (LLMS) AND OUR EXTENSIVE PROPRIETARY PRODUCT DATA, HAS BEEN WELL-RECEIVED BY USERS FOR ITS ABILITY TO PROVIDE ACCURATE, RELIABLE ANSWERS

How important is data in achieving AI's full potential?

High-quality, clean, and comprehensive data is the foundation of effective AI models. Our AI strategy focuses on using data to drive decisionmaking and improve operational efficiency. We use AI to optimize inventory levels, enhance logistics, and implement smart manufacturing processes. At the same time, we cannot wait for the perfect data setup to come

> "High-quality, clean, and comprehensive data is the foundation of effective AI models"

along. We need to explore solutions but, in the long run, the output – and, above all, scalability – will require an ongoing effort on the data side. We recognize that data is a strategic asset, and we are investing in the infrastructure and expertise needed to unlock its full potential. We are also exploring techniques like synthetic data generation to augment our existing datasets and improve the robustness of our AI models.

How are you managing the AI talent shortage?

SKF has implemented several initiatives. We have launched an AI Ambassador Program to upskill our employees and create a network of AI ambassadors who can educate their colleagues on entering the AI domain. We also provide digital content via our learning platform. Additionally, we are investing in formal training, community learning, and hands-on experimentation to boost AI competencies across the organization. We also collaborate with external partners and academic institutions to secure the necessary resources and expertise to build and scale AI applications. For an industrial organization like ours, it is important to continue to upskill our current workforce while ensuring an inflow of new and relevant competencies from the market. We have also launched a PhD program in AI, demonstrating our commitment to developing deep internal expertise in this critical area.

"We have launched an AI Ambassador Program to upskill our employees and create a network of AI ambassadors who can educate their colleagues on entering the AI domain"

MANUFACTURING IN THE 2020s

How do you assess the new technologies you are working with?

Technologies such as AI, IoT, 3D printing, and big data analytics are powering everything from predictive maintenance and rapid prototyping to real-time monitoring and quality control. Robotics is becoming more sophisticated, moving beyond simple repetitive tasks to collaborating with humans. Automation has been key in SKF for decades, and for a long time we have run manufacturing operations with very limited human intervention. One of the key growing uses of tech in the factory is in inspection and product quality assurance. We can embed the tribal knowledge of our people, accumulated over decades, into tools that can then make informed and consistent decisions. We are also able to collect that information to refine the models and our product digital twin and are seeing the increasing influence of additive manufacturing technologies, such as laser cladding, which offers new possibilities for remanufacturing and repairing bearings. I think we're at an exciting time in manufacturing, where these technologies are starting to truly transform organizations.

> **"Robotics is becoming more sophisticated, moving beyond simple repetitive tasks to collaborating with humans"**

> **"We can embed the tribal knowledge of our people, accumulated over decades, into tools that can then make informed and consistent decisions"**

How critical is cybersecurity for large manufacturing companies such as SKF?

From individuals to multinational enterprises, in today's hyper-connected world, cybersecurity is critical. In manufacturing, the additional risk to manage is in information technology/operational technology (IT/OT) convergence, which makes security in the physical world an integral part of our cybersecurity. Moreover, as operations become more dependent on digital availability, protection of those digital systems becomes even more business-critical. Cybersecurity is no longer just a nice-to-have, it's a fundamental imperative for ensuring business continuity, a competitive differentiator, and the key to building trust with customers and partners.

How does tech support the launch of new products and services?

Technology is a great enabler in bringing new products to the market. Firstly, the ability to refine designs and conduct virtual validation reduces the need to prototype and re-prototype. New processes, more suited to smaller-scale manufacturing, allow more rapid prototyping. As the product moves into manufacturing, we can simulate process flows, using things like automation and robotics to minimize downtime. Then, manufacturing data becomes valuable in the digital twin as a part of moving downstream and to the customer - things like product tolerances at the individual bearing level, calculations of embedded CO2, etc., allowing matching of bearings, better forecasts of downstream environmental impacts, and enabling re-manufacturing. Essentially, a whole circular service business, enabled by technology.

> **"Going forward, our services and intelligent solutions will be key differentiators in building customer relationships and strengthening our position in the aftermarket. It's a whole new way of doing business, and it's super-exciting!"**

But here's the best part: we're not just selling products anymore. We're offering a broad portfolio of products, services, and solutions for numerous industries. Our intelligent solutions enable many of our more advanced service offerings. Going forward, our services and intelligent solutions will be key differentiators in building customer relationships and strengthening our position in the aftermarket. It's a whole new way of doing business, and it's super-exciting!

How is technology enabling your sustainability journey?

Technology is a powerful ally in our sustainability journey, making our ambitious targets realistic. We aim to decarbonize our operations by 2030 and reach net-zero emissions in the supply chain by 2050. We develop products and solutions that enable clean technology industries, such as renewable energy generation. By making our products lighter, more efficient, and recyclable, we help customers reduce friction and extend service life, among other sustainability benefits.

Also, remanufacturing is not just about traceability, but the analysis of used components to assess feasibility of remanufacturing. Traditionally, the inspection was conducted entirely manually by experts. Now, people in the field can use digital tools developed on mobile platforms and embedded with SKF knowledge and AI analytics, meaning more bearings can be assessed for remanufacture-ability, and fewer will be shipped out, only to be rejected at on-site inspection.

Furthermore, technology is enabling us to optimize our operations, from reducing energy consumption in our factories to minimizing environmental footprint across the supply chain. Technology, along with ecosystemic collaboration, empowers us to develop more sustainable products, optimize our operations, and help our customers achieve their own sustainability goals.

WE AIM TO DECARBONIZE OUR OPERATIONS BY 2030 AND REACH NET-ZERO EMISSIONS IN THE SUPPLY CHAIN BY 2050

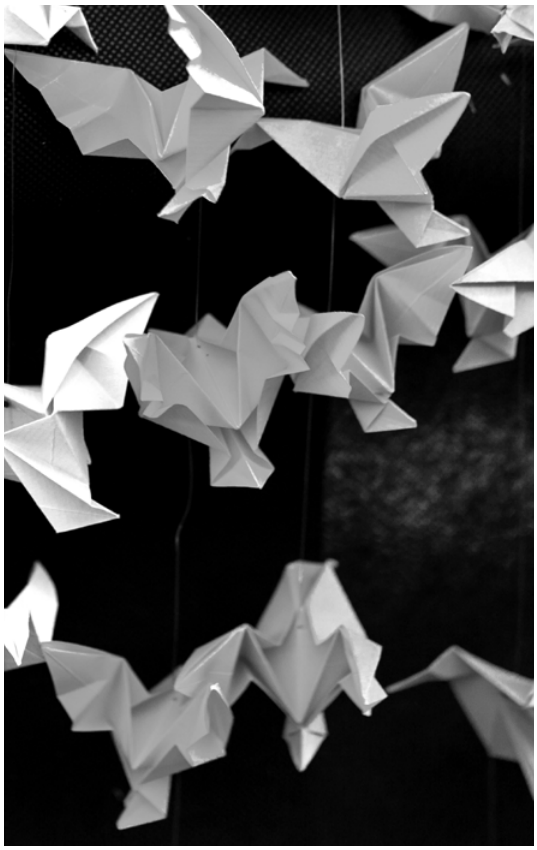
ESTABLISHING A TECH MINDSET

How can we encourage more women into technology?

We need to start early. Women must be exposed to STEM [Science, Technology, Engineering and Mathematics] subjects from a young age. And we need to make sure they are aware of the amazing women role models in tech for them to look up to! Scholarships, support programs, and creating a welcoming environment in schools and workplaces are all key. We also need to make sure everyone feels included and has equal opportunities. At SKF, we know that diversity and inclusion are not just nice-to-haves – they're essential to our success. We're taking positive steps to make sure everyone has the chance to succeed. As a female CTO, I'm in a minority. My goal is that this should not be the case for the next generation of female executives.

As a female CTO, I'm in a minority. My goal is that this should not be the case for the next generation of female executives"

In a large organization, how can you drive a culture that embraces tech?

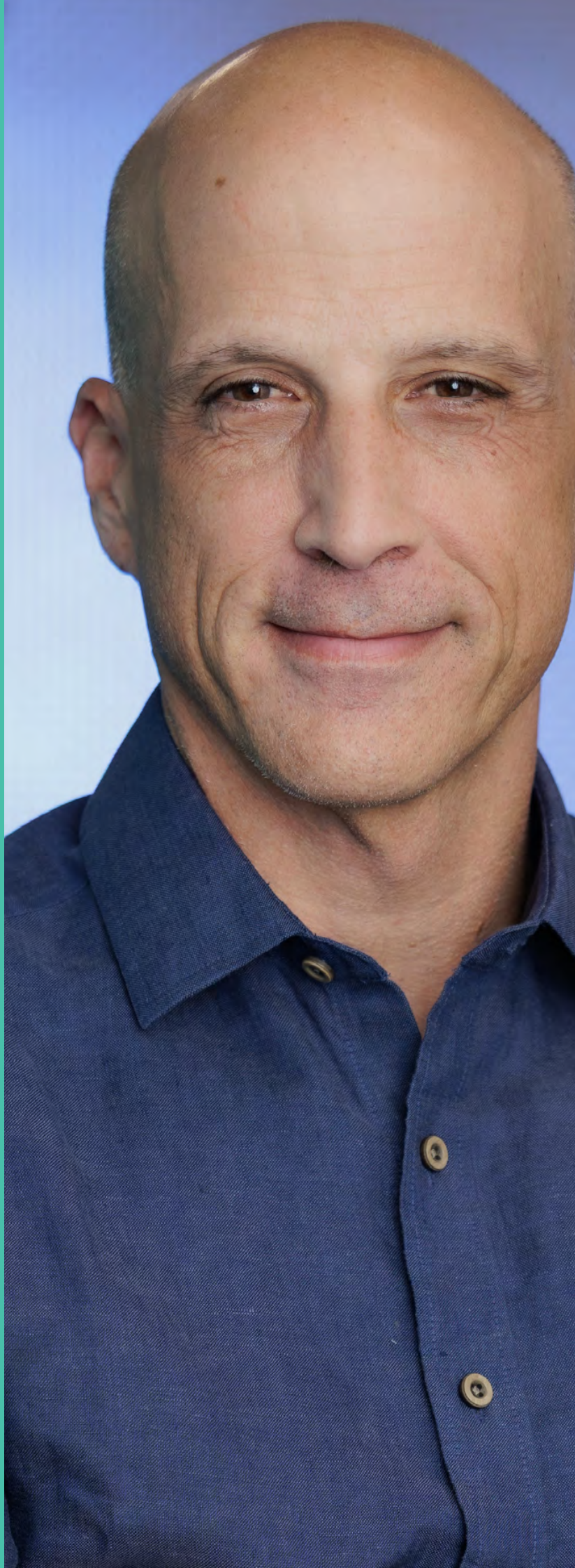


It starts at the top. Leaders are crucial to getting everyone on board with new technology. They need to set a clear vision for how specific tech will help the organization achieve its goals and then make sure we have the budget and resources to make it happen. But it's not just about throwing money at the problem. Leaders need to lead by example, show they are excited about new tools, and make sure everyone feels comfortable using them. We need to create a space where people feel safe to try new things and learn from their mistakes. And, let's be honest, the pace of change is crazy these days. Leaders need to stay on top of AI and all the other new technologies that are popping up. We can't afford to get left behind.

With more and more competition out there, it's clear that organizations that can use technology effectively are going to come out on top in 2025. It's up to us as leaders to empower our teams to embrace technology and use it to their advantage.

Annika Ölme
Chief Technology Officer
SKF Group

"Leaders need to stay on top of AI and all the other new technologies that are popping up"



MIKE CRISAFULLI

SVP and CIO, Connectivity & Platforms

Comcast

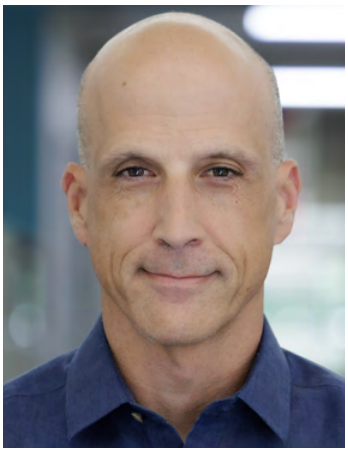
WHEN IT MEETS AI

Mike Crisafulli is Senior Vice President and Chief Information Officer, Connectivity & Platforms at Comcast, where he leads the design and operation of the company's digital core to deliver seamless connectivity and exceptional experiences for customers and employees. This entails leading large-scale digital transformation of web, mobile and desktop products and platforms. Before his current role, Mike served as Senior Vice President of Residential Services and SVP of Product and Platform Services Development at Comcast, where he oversaw strategic planning and delivery of systems impacting the entire customer lifecycle. Mike holds a bachelor's degree in Information Systems from George Mason University and an MBA from the University of North Carolina at Chapel Hill. Outside of work, he is a dedicated community volunteer, serving as an emergency medical technician and firefighter for over 25 years.

How has the role of IT at Comcast changed, and which business drivers have pushed that transformation?

Mike Crisafulli: The big tech moves – starting with cloud and microservices, and now AI – have all been about helping us go faster and be more efficient in delivering capabilities across all our lines of business. IT has become primarily an enabler of speed and efficiency.

At the same time, business pressures have increased dramatically. The advent of 5G and fixed wireless broadband created new competitors in connectivity. We operate now in a hyper-competitive environment, where we must do more with less. For IT, that translates into a relentless drive for efficiency, agility, and quality. There's constant pressure to launch new products faster and continuously improve the customer experience [CX], while optimizing existing operations.



Mike Crisafulli
SVP and CIO, Connectivity & Platforms, Comcast

"Our technology function has evolved from back-office support arm to critical strategic partner"

Our technology function has evolved from back-office support arm to critical strategic partner. We adopt modern tech not for its own sake, but to support business requirements, whether that's launching new streaming experiences or improving broadband reliability. Major external changes (such as wireless broadband competition and streaming) have pushed agility and efficiency in IT, aligned tightly with business strategy.

THE PACE OF CHANGE IN AI OVER THE LAST YEAR HAS BEEN ASTOUNDING

Which new technologies or capabilities will matter most to you and to Comcast in the next two years?

Mike Crisafulli: Without a doubt, AI – especially generative and agentic AI – is front and center. The pace of change in AI over the last year has been astounding. Over the next 24 months, I see these AI capabilities making the biggest impact, both in the products and services we deliver to customers, and in how we operate internally.

We're exploring AI to enhance user experiences and automate more complex functions (network optimization, personalized content recommendations, and so on). But where I'm most excited is applying AI internally to our software engineering and IT operations. There is enormous potential to reduce complexity in our legacy systems, automate routine tasks, and even generate code or test cases using AI. We have other priorities, such as evolving our cloud infrastructure and bolstering cybersecurity, but AI is the new frontier.

> "Where I'm most excited is applying AI internally to our software engineering and IT operations"

STAYING AHEAD OF THE CURVE

How do you keep up with the rapid pace of technological development?

Mike Crisafulli: Personally, I try to absorb information continuously. For example, I listen to tech podcasts that focus on emerging trends. More importantly, we have a large organization full of curious, passionate people, and a lot of knowledge flows in through them.

We've built mechanisms into our operating model to foster continuous learning and innovation and create a grassroots organic flow of knowledge. For instance, we run an internal event called "Knowledgefest," a dedicated day of learning, where employees present to thousands of their peers about cool innovations or lessons learned across a variety of technical tracks. We also have a longstanding tradition of hosting "Lab Week" – essentially a hackathon week – a few times a year, where employees can experiment with new ideas or technologies.

Before Lab Week kicks off, employees start to submit ideas, and teams form around the most promising ones. We also offer up challenges connected to broad strategic priorities (say, CX improvements, entertainment or network innovation). During the hackathon, teams work intensively on their projects, and at the end we hold a science-fair-style demo day. We identify the best projects, which are then developed, potentially into production. Some of our most impactful new solutions have come out of Lab Week. And it's not limited to traditional IT folk. We often have cross-functional participation from business units, which brings in diverse perspectives – and gives employees an opportunity to network and connect with colleagues from other teams.

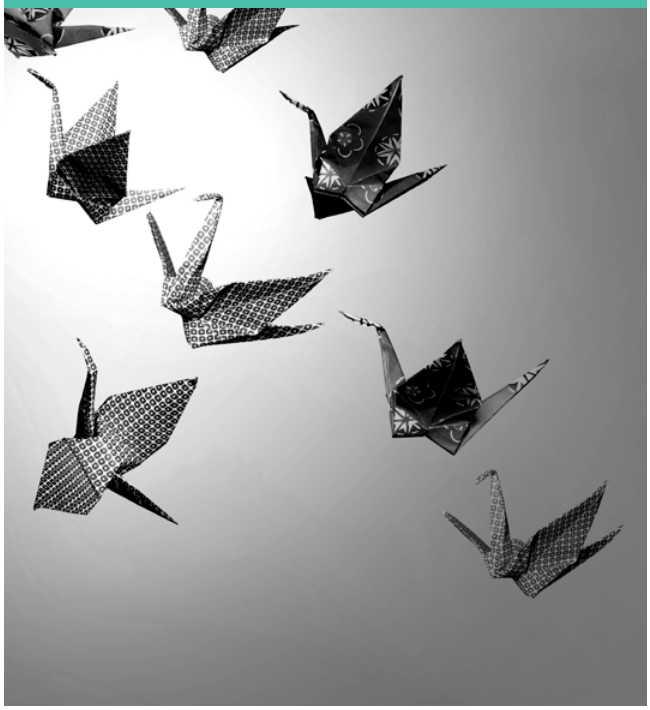
AI AND THE FUTURE OF SOFTWARE ENGINEERING

Where are you seeing the biggest impact and greatest operational value of the application of AI and Gen AI?

Mike Crisafulli: The biggest AI-driven transformation is in software engineering and IT. We recently used Gen AI to reimagine a core domain of our work: the software development lifecycle. This arose from my team's own experimentation. Over the past few months, we built out a new Gen-AI-powered developer workflow, essentially a GenAI-based SDLC [software development lifecycle]. About 700 of our engineers use this AI-augmented development workflow in their day-to-day work, and it has fundamentally changed how they operate. They're now interacting with AI tools that can generate code snippets, create test cases, draft user stories from plain English requirements, perform impact analysis, and so on. This toolset accelerates the upfront phases of development, from initial requirements to a ready-to-code solution design. Ultimately, we will roll it out to many software engineers across the organization.

There are definitely AI pilots in other parts of Comcast. We also have a couple of major customer-facing AI initiatives underway. But a key part of AI adoption today is really improving our internal software development processes: developer productivity and output quality.

"About 700 of our engineers use this AI-augmented development workflow in their day-to-day work"



If we project forward – to the year 2030, say – how much of IT work will be AI-driven versus human driven?

Mike Crisafulli: I'm pretty bullish. Based on what we've seen just in the last 6–12 months, I think in five years we could see on the order of 80% of software development tasks being automated or AI-generated in some way. We don't have end-to-end automation but there's already a lot of human-assisted automation happening in generating code, testing, deployment.

> "I think in five years we could see on the order of 80% of software development tasks being automated or AI-generated in some way"

Developers today spend a considerable part of their time coding, and the rest on requirements, design, test cases, impact analysis, user story generation. So, when we started automating the upfront parts, it's already had a huge impact – and when you add in the rest of the lifecycle, like automated testing and auto-deployment, it's hard to imagine less than 80% of it being AI-driven within five years.

With AI coming into play, how do you ensure your teams remain innovative and that the IT–business partnership thrives?

Mike Crisafulli: At Comcast, IT doesn't operate in a vacuum. I've always pushed for a tight partnership with our business stakeholders. With the emergence of Gen AI, that partnership is becoming critical. To develop AI use cases and scale them, you need deep integration of technical and business expertise.

That said, we're still learning which are the best models of collaboration in an AI-driven context. One thing we learned from our internal AI rollout is that change management is huge. Rolling out AI-powered tools is the easy part – we've needed to put a lot more energy and focus into change management and helping teams adapt to new ways of working.

Introducing AI isn't just a technical exercise. It changes how people do their jobs. Now, if I extend that lesson to the broader business, the change management challenge is even bigger.

For our most strategic AI initiatives, we've started creating cross-functional "AI pods." In these AI pods, product owners, business analysts, and engineers are all part of one agile team. It's like forming a mini startup within the company, focusing on a specific business problem and using AI as an accelerator. We're piloting it on a couple of high-priority projects. But, already, it's promising. We have business stakeholders working with developers, and even using the AI tools together to define a solution. This brings a shared understanding and much faster iteration. That real-time collaboration is powerful.

Different areas across Comcast have different maturity in product ownership. Historically, some platforms didn't even have formal product owners on the business side. In our customer-facing digital experiences, we have UX designers and business leads deeply involved, whereas some back-end systems were more IT-driven. So, we will need to vary our approach to rolling out this new integrated model. But broadly, I see AI acting as a catalyst for closer IT–business integration. To get the most out of these AI tools, we have to rethink roles and break down silos that have existed for decades.

AI technologies are changing fast. We'll continue to have opportunities to educate our business partners about what AI can and cannot do, so they can ideate with us. The more tech-fluency on the business side, the better. It means everyone speaks the same language, at least to some extent.

I believe this "one team" approach will yield a whole new level of partnership. To succeed, AI relies on tech and business working in concert. Culturally, we are fostering curiosity, continuous learning, and listening closely to the business on what will move the needle for them. It's an exciting evolution in how we work together.

I SEE AI ACTING AS A CATALYST FOR CLOSER IT–BUSINESS INTEGRATION

BALANCING SPEED OF PROGRESS AND AVOIDANCE OF TECHNICAL DEBT

How do you balance delivering new features quickly with the need to manage technical debt and maintain stable platforms?

Mike Crisafulli: This is a classic dilemma for any large IT organization. The advent of AI cuts both ways here. On one hand, AI will let us deploy new features faster. But, if we're not careful, that could exacerbate technical debt, because we might spin up new services rapidly without the usual constraints, potentially increasing the complexity of our estate. For example, we don't want to launch 100 new microservices powered by AI and forget to retire the 50 old ones they were meant to replace.

> "I'm optimistic that we can apply the same AI power to "cleaning up" as we do to building new things"

On the other hand, I see a huge opportunity to use AI to tackle technical debt. Imagine AI tools that can analyze legacy codebases and propose simplifications or even automatically refactor code into more modern languages/frameworks. Or AI-assisted testing that makes it easier and safer to decommission old systems. So, I'm optimistic that we can apply the same AI power to "cleaning up" as we do to building new things. In the best case, AI helps us simultaneously accelerate feature delivery and the retirement of obsolete stuff.

It still comes down to discipline and prioritization. We need to bake platform simplification into our roadmap, even as we speed up features. The goal is a balanced approach: using AI both to accelerate and simplify. But it requires conscious effort: governance to ensure we're decommissioning as fast as we're adding, and maybe even dedicating some AI capacity to hunting down inefficiencies in our architecture.

How do you prevent teams from being overwhelmed by the pace of change?

Mike Crisafulli: It does feel like the tech is moving faster than many teams can absorb, on the business side as well as the IT side.

We don't want teams so paralyzed by new options that they stop experimenting. We give them an open environment to try out new tools and

"Reimagine, don't just replicate"

ideas (within reason), so they stay engaged with the latest technology. That's the whole idea behind Lab Weeks: create safe spaces to play with what's new. But there's always a focus on business outcomes. We have to prioritize the problems we're trying to solve.

This ties into the classic build-vs-buy and portfolio management discussions. In the past, you might buy a technology solution and expect it to serve you for 2–3 years. Now, something new might emerge in six months that upends that assumption. So, we have to stay nimble. We're trying to keep a hybrid approach in our tech stack, rather than locking ourselves into one vendor or architecture, which might be outdated in a year. We modularize where we can, so if a better component comes along, we can swap it in. And we re-evaluate our portfolio priorities every quarter, or even more frequently.

In practice, it becomes a cycle: keep experimenting, while delivering incremental value. We want to be aware of what's around the corner, without that distracting us from what's possible today. There's so much we can do with the tools at hand, even if they're not perfect or the very latest, that can give us 80% of the benefit we're looking for. Let's deliver something tangible, get value, and then we can iterate when the next improvement comes. It's a balance of staying adaptable without losing focus on execution.

We also put great emphasis on an adaptive mindset. You hear clichés like, "Today is the slowest rate of change you'll experience going forward." Well, it's true. We have to internalize that. For example, I tell my leaders: we might spend four months implementing a solution and then a new technology makes part of it obsolete. And that's okay. We delivered value for those four months, and now we adapt again. The old mindset of "Set a 3-year plan and stick to it" doesn't fully work in this environment. Instead, we plan in smaller chunks, deliver in smaller increments, and be ready to pivot when needed.

This is a big cultural shift, especially in a large enterprise like ours that traditionally valued predictability and long-term roadmaps. We're retraining

ourselves to think more like, "What value can we deliver in the next month or quarter with what we know now?" and then iterate. It's an agile mentality taken to the next level due to the extreme pace of change. We still have an overall strategy, but we're fluid in how we get there.

In short, to prevent overwhelm, we narrow focus to what matters (business value) and cultivate an adaptive culture. Encourage the team to try new things, but also to accept that not every new thing will stick. Celebrate quick wins and learning, not just big, long-term projects. The goal is that our people don't fear the change but see it as exciting – as long as we're delivering outcomes along the way.

How will automation and AI change your approach to IT governance and oversight?

Mike Crisafulli: I think AI is going to reshape governance significantly. A lot of governance today is about policy enforcement, approvals, auditing what people do – tasks that could be automated. If we apply generative and agentic AI to these areas, we can imagine things like automated policy definition and real-time compliance monitoring. I see governance shifting to be much more about strategic oversight of the AI, rather than humans doing all the checking. For example, you might have AI agents that handle certain approvals or keep audit trails. Our job is to audit the auditor. We'll need robust traceability of exactly what the AI did, what decisions it made, and why.

> **"As AI takes over routine governance tasks, humans will focus on meta-governance: designing the policies, reviewing exceptions, and guiding the AI"**

We're working on an orchestration layer for AI agents. Think of it as a management framework for AI "employees." In many respects, we're going to treat those agents as we would human team members. That means assigning roles, monitoring performance, setting up controls and logs for everything they do. So, as AI takes over routine governance tasks, humans will focus on meta-governance: designing the policies, reviewing exceptions, and guiding the AI. It's a shift from doing the work to overseeing the work. And because AI can give more visibility into processes than we've ever had (through logs, analytics, etc.), we might actually get more transparency and accuracy.

What is your biggest takeaway from this transformation journey?

Mike Crisafulli: We're all learning. We're at various stages across domains. I'm sticking to this: change the way we work. Don't just automate something that's already broken. Prepare your workforce for change and being adaptive and keep your eye on outcomes.

Much of it is change management. Much of it is new tech, governance, and privacy. For our consumers, our ways of thinking need to change as much as the tech.

That's the key. Otherwise, we're just "AI-ing" what exists today – maybe faster, maybe more efficient but if we don't have the talent to reimagine what's possible, especially for our products and consumers, it's all for nothing. That's why we're focused on talent alignment, change management, and adaptability as much as the tech.

Reimagine, don't just replicate. Invest in your people and change management, and stay laser-focused on the outcomes you want. It's a daunting, but truly exciting time. I'm confident that, by keeping those principles in mind, we'll navigate whatever the future holds.

Mike Crisafulli
SVP and CIO, Connectivity & Platforms, Comcast

"We want to be aware of what's around the corner, without that distracting us from what's possible today"

DANIELA RUS

Director, Computer Science and Artificial Intelligence Laboratory (CSAIL)

MIT

WHEN AI MEETS ROBOTICS

Daniela Rus is the Andrew (1956) and Erna Viterbi Professor of Electrical Engineering and Computer Science and Director of the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT. Daniela's research interests are in robotics, mobile computing, and data science. She is a Class of 2002 MacArthur Fellow, a fellow of the Association for Computing Machinery (ACM), the Association for the Advancement of Artificial Intelligence (AAAI), and the Institute of Electrical and Electronics Engineers (IEEE), and a member of the National Academy of Engineering (NAE), and the American Academy of Arts and Sciences. She earned her PhD in Computer Science from Cornell University.

What inspired you to pursue a career in robotics and artificial intelligence (AI)?

Daniela Rus: I've always been drawn to the intersection of mathematics and computer science, but what really inspired me was the idea of computation that interacts with the physical world. Systems that are not just abstract or digital, but grounded in the messiness of materials, motion, and uncertainty. Unlike the clean, discrete world of traditional computation, the real world is continuous, noisy, and unpredictable. I found that challenge exciting and compelling.

Robotics and AI offered a way to explore that tension: to work on algorithms and models that must adapt, learn, and make decisions in the face of ambiguity. I liked that it was "mathy" but also physical. You could watch the output of your code translated into movement, interaction, or behavior.

A big part of my inspiration also came from science fiction. I have always been fascinated by the idea of intelligent machines as collaborators, explorers, and extensions of human capability. That evolved into a curiosity about how we might build systems that reason, act, and evolve in the real world.

Daniela Rus
Director, Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT

IN MANUFACTURING AND LOGISTICS, ROBOTS WILL NO LONGER BE LIMITED TO REPETITIVE TASKS

FROM AI AND ROBOTICS TO "PHYSICAL AI"

How do you envision robotics transforming industry?

Daniela Rus: We're entering a phase where robotics will move far beyond structured factory floors. We'll see a shift from rigid, pre-programmed systems to intelligent, reconfigurable machines that can operate in dynamic environments, whether that's a warehouse, a farm, a hospital, a home, or even a disaster zone. This will fundamentally reshape how we think about automation as a tool for augmenting and extending human capability.

In manufacturing and logistics, robots will no longer be limited to repetitive tasks. They'll collaborate with humans, adapt to changes in workflows, and learn new skills without reprogramming. In healthcare, we'll see robots that can assist with surgery, rehabilitation, or elder care. These robots will be responsive to the physical and emotional needs of individuals. In agriculture and construction, "soft" and autonomous systems will navigate off-road unstructured terrain, making decisions in real time based on sensor data and environmental cues.

> "In healthcare, we'll see robots that can assist with surgery, rehabilitation, or elder care"

Your work spans robotics, mobile computing, and data science. Where do these fields converge, and what new possibilities does this create?

Daniela Rus: These fields are converging in exciting and transformative ways. Robotics provides embodiment, meaning machines that sense and act in the physical world. Mobile computing brings connectivity, responsiveness, and access to distributed resources, enabling robots to operate flexibly in real time and in diverse environments. And data science adds the layer of intelligence, with algorithms capable of extracting patterns from rich sensor data, enabling learning from experience, and supporting predictive decision-making.

At their intersection, we're seeing the rise of physically grounded intelligent systems, which are robots that can perform tasks and learn from the world, adapt to new contexts, and collaborate with humans and other machines. For example, mobile robots can now continuously collect environmental data, learn optimal behaviors from it, and update their policies on the fly, all while staying connected to cloud platforms or edge networks that support coordination and insight-sharing.

This convergence opens the door to new capabilities, from self-reconfiguring soft robots that adapt their forms and functions in real time, to autonomous systems that can operate in remote or unpredictable environments with minimal oversight. It's about building systems that are adaptive, networked, and understand the world they move through.

You wrote a book on how robots and humans can work together. How do you foresee this collaboration evolving?

> "Increasingly, robots are teammates, rather than tools"

Daniela Rus: Increasingly, robots are teammates, rather than tools. As AI becomes more capable, robots will continue to take on repetitive physical tasks and assist with complex activities including decision-making, adaptation, and perception in dynamic environments. This evolution means that collaboration is about designing systems that respond to human intent, complement human strengths, and adapt to real-world complexity.

As AI meets robotics, I foresee this collaboration becoming more fluid and

"The key is building systems that are trustworthy, interpretable, and adaptable, so humans can rely on them, understand their limitations, and work alongside them with confidence"

context-aware. Robots will learn from human behavior, understand social and environmental cues, and adjust their assistance accordingly, whether it's a warehouse robot coordinating with a human worker, a surgical assistant anticipating a clinician's next move, or a home robot learning a daily routine.

The key is building systems that are trustworthy, interpretable, and adaptable, so humans can rely on them, understand their limitations, and work alongside them with confidence. In the long term, I envision teams of humans and robots learning together, each bringing unique capabilities: humans with creativity and judgment, robots with endurance, precision, and data-driven insight. The result will be collaborative intelligence, where together, people and robots will be able to do more than people alone or robots alone.

"Robots will learn from human behavior, understand social and environmental cues, and adjust their assistance accordingly"

How do you define "physical AI," and what are the primary hurdles to its widespread implementation?

Daniela Rus: Physical AI refers to using AI's capability to understand text, images, and other online data to make real-world machines smarter. It integrates AI into machines that interact with the physical world. That is, robots that go beyond executing pre-programmed motions, to adapting and learning in real time. It goes beyond digital intelligence by embedding learning, decision-making, and reasoning into systems that must deal with uncertainty, friction, noise, time, space, physics, and constraints. In other words, the messiness of the physical world.

We are developing the foundations of physical AI at the intersection of machine learning [ML], control theory, materials science, and embodied interaction. It's about teaching machines to respond intelligently and adaptively, learning and improving over time.

The hurdles to implementing physical AI are significant. First, data is harder to acquire in the physical world because to do so is expensive, time-consuming, and it's often incomplete or even unavailable. Second, in the physical world, we cannot have mistakes and hallucinations. Safety and reliability are harder to guarantee when AI directly affects physical motion. Third, most current AI architectures are not well suited to real-time, resource-constrained settings, nor to tasks that require spatio-temporal correlations. Also, co-designing intelligence with mechanical form, so that learning is distributed across sensors, actuators, and materials, is still in its early days.

These are some of the key challenges we need to tackle to build intelligent systems that are resilient, trustworthy, and grounded in the world we live in.

Can you help us understand liquid neural networks [LNNs]?

Daniela Rus: LNNs are a new class of AI model designed to be adaptive, compact, and interpretable, especially in dynamic environments such as robotics and mobile computing. Unlike traditional neural networks, which use fixed architectures and activation functions, liquid networks change their internal dynamics in response to inputs over time, much like biological neurons.

At their core, LNNs are continuous-time models, inspired by the differential equations in the neural system of small species. This means they process data in a way that naturally adapts to variable inputs, making them especially effective for real-time, sensor-driven applications such as autonomous vehicles, drones, and wearable systems.

A key advantage of LNNs is their efficiency. They can often achieve strong performance with fewer parameters, use much less energy, and offer significantly faster inference than traditional networks such as transformers. They are also more interpretable, because their mathematical structure makes it easier to trace how inputs evolve through the system.

LNNs are a step toward trustworthy, adaptable AI, meaning systems that are not only powerful but also responsive to the real world, and more aligned with how humans and animals learn and react in dynamic environments.

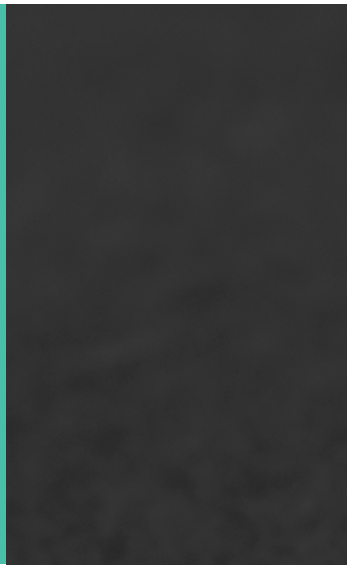
What are the biggest misconceptions about AI and robotics today?

Daniela Rus: One major misconception is that AI and robotics are the same. While they're deeply connected, they serve different functions. AI is about decision-making, learning, and pattern recognition, while robotics is about physical action and interaction. Real-world systems often combine the two, but it's important to understand their distinct roles – and that progress in one doesn't automatically solve challenges in the other.

> "AI is about decision-making, learning, and pattern recognition, while robotics is about physical action and interaction"

Another common myth is that AI-equipped robots are close to human-level intelligence or autonomy. Today's systems are highly specialized. A robot that performs well in a warehouse may fail completely in a home. Generalizing across environments, tasks, and social contexts remains an open research frontier.

"There's also a tendency to assume that AI will replace humans outright, when in fact the most powerful systems are designed to augment human capabilities, not substitute them"



There's also a tendency to assume that AI will replace humans outright, when in fact the most powerful systems are designed to augment human capabilities, not substitute them. Thinking in terms of "co-bots" or assistive intelligence better reflects the direction in which the field is heading.

People often overlook how much support in the form of infrastructure, data, and human supervision AI and robotics still require. Behind every smooth demo is a complex support system. Making these technologies scalable, safe, and trustworthy "in the wild" is still a work in progress.

THE HUMAN IMPACT OF AI AND ROBOTICS

How do you think we can balance the growing energy demands of AI with sustainable energy usage?

Daniela Rus: Balancing AI's rapid growth with sustainable energy use requires technical innovation and system-level thinking. As AI models, especially foundation models and deep learning systems, become larger and more capable, their training and deployment can consume vast amounts of energy. The challenge is to ensure that AI's benefits don't come at the cost of environmental harm.

One key strategy is to develop more efficient AI architectures. For example, LNNs [see above] offer strong performance with fewer parameters and lower compute needs. They are well suited to real-time applications on edge devices.

> **Sustainability must become a core metric of AI system design, alongside performance and accuracy"**

Another strategy is to optimize AI models after training. Sparsity, quantization, and model distillation are active areas of research that aim to reduce the computational footprint without sacrificing accuracy.

We also need to move intelligence closer to the data. Running compact AI models like LLNs on edge devices such as phones, sensors, and robots can dramatically reduce energy and bandwidth requirements. This is especially important for physical applications, where low-latency, on-device intelligence is both more sustainable and more responsive.

Sustainability must become a core metric of AI system design, alongside performance and accuracy. This includes optimizing data center operations, using renewable energy sources, and incorporating lifecycle assessments into AI development. By aligning AI innovation with environmental stewardship, we can ensure that intelligent systems benefit both people and the planet.

How can we design robotics and AI to serve humanity equitably?

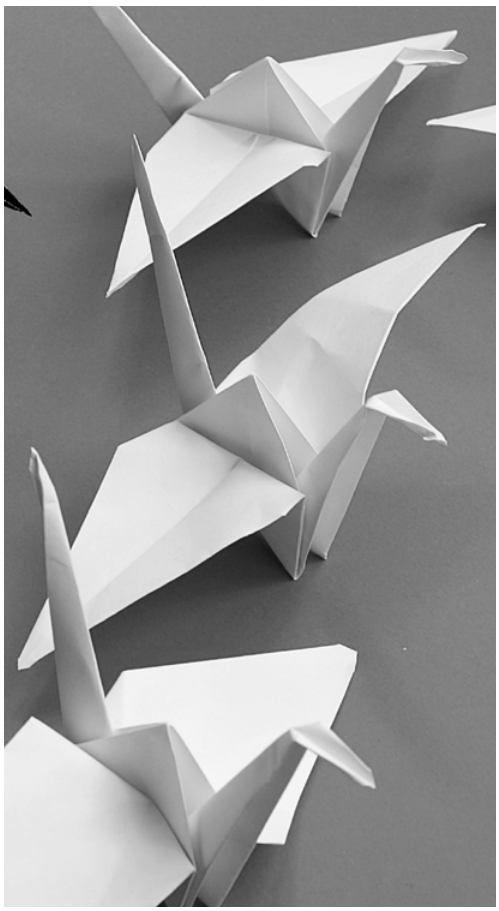
Daniela Rus: On the technical side, achieving equity requires designing systems that are robust, adaptable, and resource-aware. This includes developing AI models that perform reliably across diverse environments, user groups, and data distributions, not just in ideal or well-resourced settings. It also means creating algorithms that can operate on low-power edge devices, enabling broad deployments and uses without relying on expensive infrastructure. Techniques like few-shot learning, transfer learning, and interpretable models are essential to building systems that can be customized and audited locally. In robotics, this means building hardware and control systems that are modular, maintainable, and affordable, making real-world capabilities accessible outside of elite labs or industrial applications. In short, equity must be engineered into the foundations, from datasets and models to physical components and user interfaces.

In your view, what role should policymakers, researchers, and the public play in shaping the responsible development and deployment of intelligent machines?

Daniela Rus: Robotics and AI must be intentionally designed with inclusion, access, and long-term social impact in mind, not just technical performance or profit. Teams with interdisciplinary expertise are more likely to build systems that reflect a broader range of human experiences and applications.

> **"Robotics and AI must be intentionally designed with inclusion, access, and long-term social impact in mind, not just technical performance or profit"**

Equitable design also means thinking beyond "high-end" applications. AI and robotics should not be limited to autonomous vehicles or surgical assistants; they should also address public-interest challenges: access to education, elder care, environmental resilience, disaster response, and infrastructure repair. These are areas where commercial incentives may be negligible, but where there is great social value.



"AI and robotics should not be limited to autonomous vehicles or surgical assistants; they should also address public-interest challenges"

From a systems perspective, we need transparent, accountable, and explainable AI, especially when it is embedded in physical systems. This allows users to understand, trust, and challenge outcomes. At the same time, policies around data governance, labor impacts, and access to AI infrastructure are crucial to ensuring that benefits are felt widely.

Are you worried about machines gaining general intelligence? Are we anywhere close to it?

Daniela Rus: I think it's important to distinguish between general intelligence as we imagine it in science fiction – machines that can do everything a human can and more – and of what today's AI systems are capable. Despite rapid progress, we are not close to achieving true artificial general intelligence. Even the most powerful current models are highly specialized. They excel at pattern recognition, language modeling, or planning in well-defined environments. But they lack common sense, contextual understanding, and the flexible reasoning that even a child demonstrates.

That said, I don't think we should be complacent. The systems we do have are increasingly influential, and they can already behave in ways that are surprising, opaque, and sometimes risky when deployed at scale, especially in high-stakes applications like healthcare, law enforcement, or autonomous systems. So, while I'm not worried about machines "waking up," I am deeply invested in how we design, deploy, and govern increasingly capable AI.

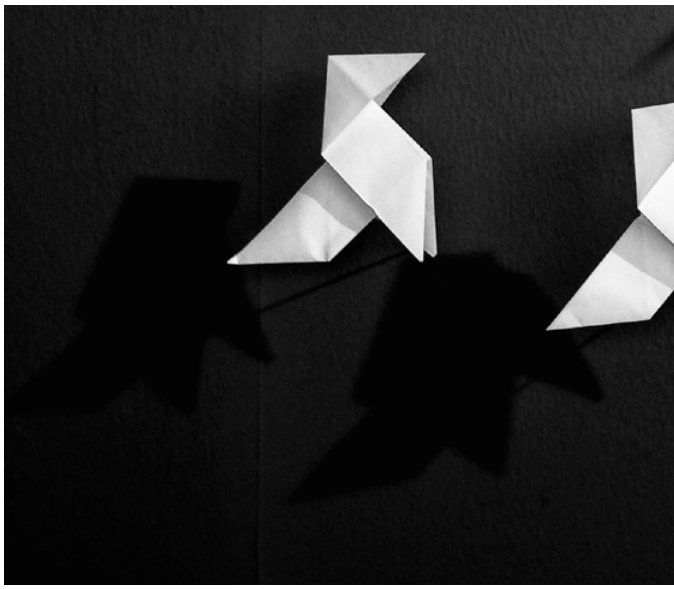
LOOKING FORWARD

What is one big breakthrough you hope to see realized in AI and robotics over the next five years?

Daniela Rus: One breakthrough I hope to see is the development of general-purpose, physically adaptive robots that can learn new skills and reconfigure their morphology to perform entirely different tasks without needing to be rebuilt or retrained from scratch. Imagine a system that can manipulate delicate surgical tools one day, then traverse rubble in a disaster zone the next, by adjusting both its form and function in response to its environment and goals.

To fulfill this vision would require advances in embodied learning, modular hardware, and adaptive control. But it would also require a broader shift, from narrowly optimized machines to self-improving systems that operate safely and robustly in the real world. If we can achieve that, robots that grow more capable through experience, grounded in physical reasoning and responsive to human needs, we'll unlock applications we haven't yet imagined.

> **"One breakthrough I hope to see is the development of general-purpose, physically adaptive robots that can learn new skills and reconfigure their morphology to perform entirely different tasks without needing to be rebuilt or retrained from scratch"**



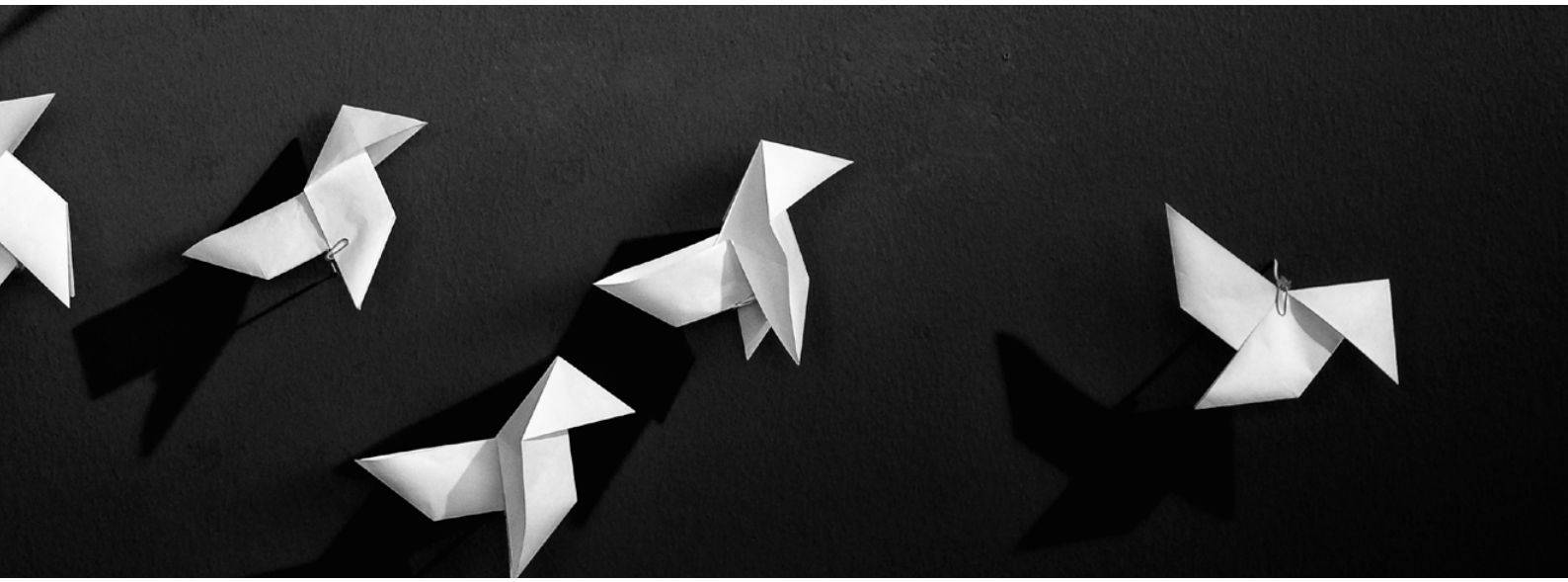
What advice would you offer to young researchers and innovators who are passionate about pursuing careers in AI and robotics?

Daniela Rus: First, stay curious and keep asking foundational questions, not just about how systems work, but about why we build them, who they serve, and what impact they have. AI and robotics are interdisciplinary by nature, so embrace the messiness: combine math with mechanics, data with ethics, and theory with hands-on experimentation. The most exciting innovations often come from connecting ideas across fields.

Second, don't be discouraged by how fast the field is moving. There's a lot of noise, but there's also room to go deep on problems that matter. Find a research question or application area that resonates with your values and commit to learning the fundamentals (e.g., algorithms, systems, physics) before chasing trends.

Third, collaboration is important. Whether you're working on soft robotics or scalable ML infrastructure, real-world systems are built in teams. Seek out mentors and peers who challenge and support you. Be generous with your ideas and open to feedback.

Finally, remember that your voice and perspective matter. The future of AI and robotics isn't fixed. It's still being written. The most meaningful contributions won't just be technical; they'll be thoughtful, intentional, and centered on positive impact.



AI AND ROBOTICS ARE RESHAPING THE WORLD, AND IT'S VITAL THAT THE PEOPLE DESIGNING THESE SYSTEMS REFLECT THE COMMUNITIES THEY SERVE

What advice would you give to young women who are aspiring to a career in AI and robotics?

Daniela Rus: First and foremost: you belong here. AI and robotics are reshaping the world, and it's vital that the people designing these systems reflect the communities they serve. Your perspective is welcome and essential.

Don't wait to feel "fully ready" before you jump in. These fields move fast and can feel overwhelming, but no one starts out knowing everything. Focus on building strong fundamentals in math and computing, and follow your curiosity, whether it's in ML, hardware design, ethics, or applications like healthcare or climate. Interdisciplinary thinking is a strength, not a detour.

Surround yourself with mentors, peers, and communities that support you. There will be moments of self-doubt. What matters is persistence, passion, and finding people who believe in your growth. Don't be afraid to ask questions, take up space, and contribute your ideas.

Remember that success isn't just about what you build, but why you're building it. Let your values and imagination guide you.

Daniela Rus
Director, Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT

"Success isn't just about what you build, but why you're building it. Let your values and imagination guide you"

YVES CASEAU

Group Chief Digital and Information Officer

Michelin

WHEN CODE MEETS ROAD

Yves Caseau is in charge of Digital and Information Systems at Michelin Group. He joined Michelin in 2017 as CIO and has worked extensively on modernization, data-driven transformation, and quality of service. He was previously associated with the AXA Group, and Bouygues Telecom.

He has taught the "Information Systems Theory and Practice" lecture at École Polytechnique for three years and is a frequent public speaker on information systems architecture. A former student of the École Normale Supérieure in Paris, he holds a PhD in Computer Science from Paris XI University and a habilitation professorial qualification from Paris 7 University, as well as an MBA from the Collège des Ingénieurs, also in Paris. Yves is a member of the Académie des Technologies, and the author of books about information systems, lean management, and enterprise organization.

How is software impacting the automotive industry? And what does that mean for Michelin?

Yves Caseau: There is a dilemma for car manufacturers: they can either build the software themselves and risk lagging the rest of the market, or partner with organizations such as Android and risk losing differentiation and know-how.

The overall trend is obvious and unstoppable: cars are becoming computers with added features. The key issue is ecosystems. Open or closed marketplaces, APIs [application program interfaces], partnerships, and alliances. This is why it's so important for Michelin.

Software-defined vehicle design goes hand in hand with virtual car design and digital twins. Michelin is strong in tires and simulation. This creates opportunities but also risks. For example, if cars are designed digitally around a competitor's tire, a Michelin tire might be less suitable, even if it's structurally superior.

Yves Caseau
Group Chief Digital and Information Officer, Michelin

> **"The overall trend is obvious and unstoppable: cars are becoming computers with added features. The key issue is ecosystems"**

We need to understand how fast this shift is happening and how many ecosystems will emerge – one per manufacturer, or a few shared platforms. We've seen OEMs [original equipment manufacturers] such as Mercedes, BMW, Volkswagen, and others vacillating between building their own systems and partnering with tech companies like Google.

WE'VE SEEN OEMs [ORIGINAL EQUIPMENT MANUFACTURERS] SUCH AS MERCEDES, BMW, VOLKSWAGEN, AND OTHERS VACILLATING BETWEEN BUILDING THEIR OWN SYSTEMS AND PARTNERING WITH TECH COMPANIES LIKE GOOGLE

The shift toward software-defined vehicles is inevitable. It's being accelerated by electrification, although rollout varies by region. But it is a hard shift because you cannot play alone. You need ecosystems, critical mass, and ways to attract developers. Otherwise, you risk ending up like Nokia, where no one develops apps for the platform anymore. We have already collaborated on ABS systems, for example, showing that our digital twin expertise improves performance. But moving from physical to digital also raises issues of intellectual property and data protection.

So, the trend is clear, but the transition is complex. For Michelin, it's both an opportunity and a challenge.

Which strategic decisions has Michelin taken to shift toward software-driven mobility?

Yves Caseau: **First,** for a long time, Michelin has developed digital models of tires, mixing physical and numerical approaches. Initially, this was for our own use and for collaborations with Formula One teams and other manufacturers. About a year ago, we decided to make some of our tire twin expertise more broadly available, as it's a big market. Instead of starting with a physical tire, we begin with a digital model.

Second, once you have software-defined vehicles with APIs, sensors, and data flows, you can develop tire-related software. At first, car manufacturers

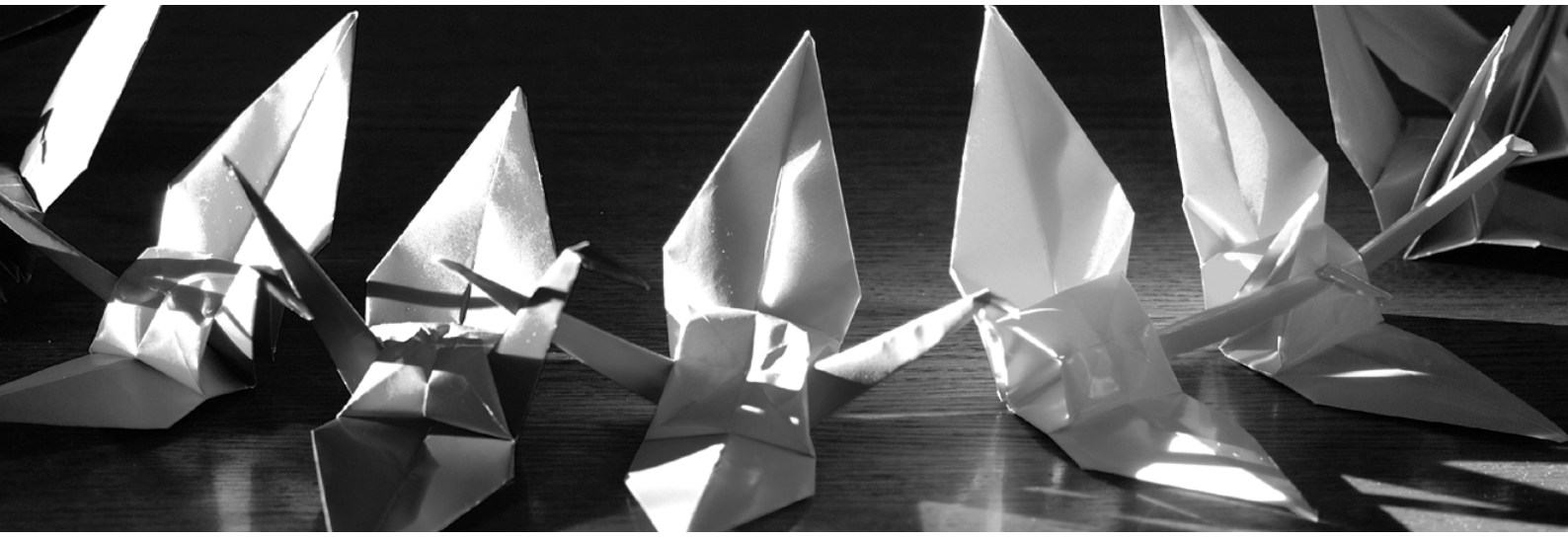
"You need ecosystems, critical mass, and ways to attract developers. Otherwise, you risk ending up like Nokia, where no one develops apps for the platform anymore"

> **Our goal is to embed Michelin software inside software-defined vehicles"**

told us they could do this themselves with their proprietary data. But they discovered that our algorithms, which we have been developing for decades, are better. We are not better data scientists, but we have a better understanding of tires. So, we are making progress here, and our goal is to embed Michelin software inside software-defined vehicles.

Third, we are looking at opportunities in vehicle app stores. We demonstrated this with a predictive wear app for Renault's electric car Mégane. There are many other potential applications, such as solutions for pickup trucks carrying heavy loads. Predictive maintenance can bring huge added value.

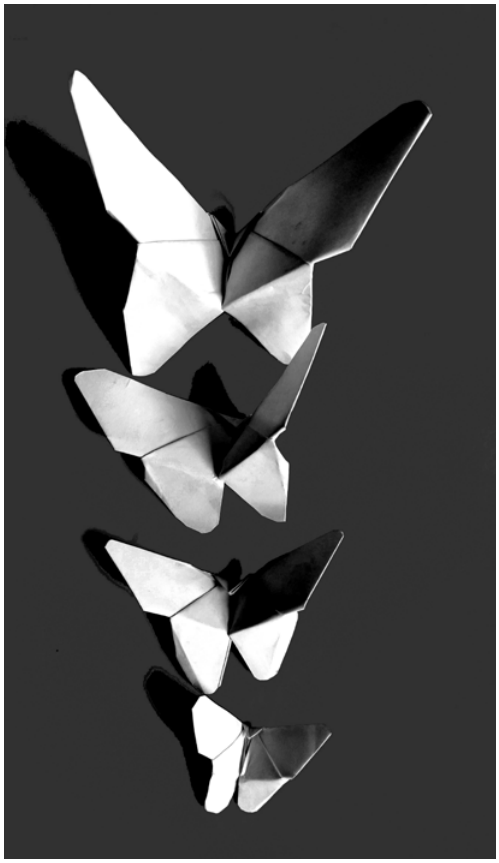
So, these are our three frontiers: selling digital tire models, improving internal vehicle functions through software, and providing add-ons via app stores. Beyond that, Michelin has a tradition of driver services, dating back to road signage 100 years ago, to digital tools like ViaMichelin in the 1990s. We believe this new era could herald a rebirth for Michelin as a company that helps people drive better.



How do you balance the ownership of data between OEMs, yourselves, and the end customers, while maintaining trust among all parties?

Yves Caseau: There is no simple answer. A large part of the discussion with OEMs and regulators is whether all the data generated by the car belongs to the driver, or should it be considered the OEM's property? OEMs are saying the data is produced by our car and there are security issues, therefore it has to be ours. But that battle is not over.

If OEMs win that case, it probably favors one-to-one data contracts, rather than an open model. That means we might go to Tesla and say: "We have this capability – do you want it?" Then, we go to BMW and propose a partnership. This might mean we focus on a few use cases, which could make progress slower.



"A large part of the discussion with OEMs and regulators is whether all the data generated by the car belongs to the driver, or should it be considered the OEM's property"

It's unclear how it will evolve. My guess is that, in the end, we will have something around data portability, with universal recognition that some domains of data belong to the user, while technical data is linked to the car. For instance, your GPS navigation data belongs to you, but engine-related data belongs to the car manufacturer.

What kind of revenue models do you see emerging for digital models of tires?

Yves Caseau: We've been trying to find examples for the past 10 years, but without much success. What we understand is that it's too early to sell data.

Ultimately, what you are selling is a feature. If that feature has a clear benefit, then it can be offered for a subscription fee, which can be shared. At the moment, it's more likely you're selling software. In other words, a capability. Typically, we sell with a yearly software fee, and that's it. Right now, we're testing the market.

Usually, we don't break even by a long way, but we say, OK, let's see if both parties agree that the added value is worth it. A typical example is this: "Tesla, if you were to do this on your own, it could cost you $1 million over two years. Instead, why don't you pay us $300,000 a year?"

Right now, the value is in the car itself. But people aren't saying, "Oh, in that price you paid, $2,000 is because you got the extra non-flat tires with this software." One day, maybe, but not yet.

Do you foresee Michelin creating dedicated software units or integrating digital skills within existing functions?

Yves Caseau: Both approaches are valid. For instance, if you look at 6S, which is a connected solution, they integrate AI capabilities and software teams.

When it comes to selling digital twins of tires, this may start as an independent team hosted by R&D that eventually becomes an independent business model. Sometimes, you integrate digital skills within each function, and sometimes you create separate teams that evolve into new businesses.

How is Michelin using AI and generative AI today?

Yves Caseau: We've been using AI for a long time. At first, it was what I would call classical AI: rule-based or statistics-based systems. We used it for scheduling, planning, routing, supply chain management, and manufacturing. About five years ago, we started using deep learning neural nets, mostly for machine vision in manufacturing, and that added value.

If I look at where AI is bringing the most value today, it's in manufacturing. We're improving electricity consumption, reducing waste, and optimizing processes.

Gen AI started to make an impact about two years ago. One of the first applications of Gen AI was helping people solve maintenance problems in factories. We also use it to summarize large amounts of information, make retrieval easier, and enable dialogue. In factories, we've moved fast and had success quickly.

MICHELIN'S STRATEGY IS THREEFOLD: TIRES, SERVICES AROUND TIRES, AND ADVANCED MATERIALS

We have similar projects for R&D, but they are taking more time. Another big use case is using GitHub Copilot to write code. Our coders are really happy with this and report productivity gains. It's still too early to say how much money we are saving, but the feedback is positive.

Strategically, this is important because the automotive industry is going through uncertainty and downturns. We are looking for efficiencies and new ways to create value. Automation, supported by Gen AI, is one way to do that.

And this leads to the next step: agentic AI. Think of it as a new form of automation, following RPA [robotic process automation]. We have a few use cases where agents are already saving money and performing well. But only about 1% of Michelin is currently exposed to it. Michelin is a big company, so I'm not expecting everyone to use agents, but if we get to 10%, that would be great progress.

Are there use cases where AI has helped you in your role as a CXO?

Yves Caseau: Definitely. For example, last month, when I came back from vacation, I had two things to do for my colleagues. I asked GPT-5 to help me and each time I did in one hour something that would usually have taken close to a business day. So I saved two days of work. I'm very happy with that.

But if you ask about the impact on the bottom line, it's not that much. I saved some time, but not in a transformative way. AI has a bigger role in R&D. We are using AI simulation and digital twins to explore designs. For instance, part of the design of our new winter tire, Alpin 7, was produced by algorithms. Our R&D department has been using simulation and AI for a while, and now it's really accelerating exploration. We don't claim to have invented a new tire with AI, but we've improved and we've been able to explore more. For us, it's an exploration tool, an acceleration tool.

What are some challenges of using AI at C-suite level? Do you see a future where you would delegate authority to an AI agent for decision-making?

Yves Caseau: That's a good question. The big challenge, as our CEO Florent Menegaux keeps reminding us, is that Michelin wants to go fast and far. To go fast, we need to learn how to use these tools, but not at the expense of becoming too dependent on automation and losing critical thinking.

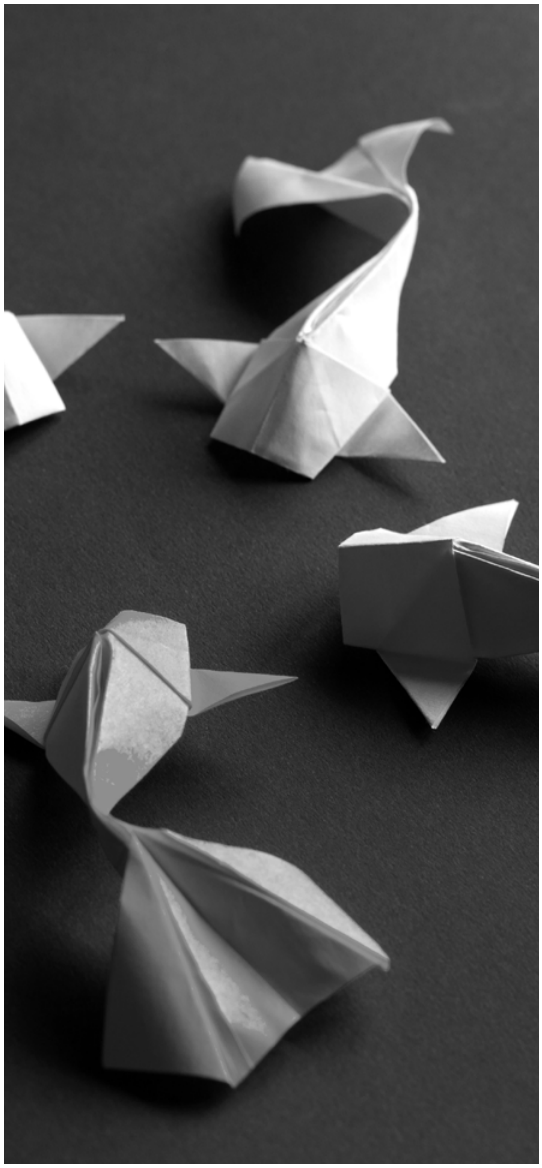
If learning is accelerated too much by AI, then you don't really learn. You need to find a balance: using the tools to go faster while retaining your learning capacity. Because the challenges two years from now won't be the same as today.

> **"If learning is accelerated too much by AI, then you don't really learn. You need to find a balance: using the tools to go faster while retaining your learning capacity"**

Another challenge is staying in control. You don't want to treat AI as a black box you trust blindly. The risk is that, because AI is usually right, the day it makes a mistake you may not notice and you keep following its instructions.

This is why practice is important. For example, this April at our Michelin North America convention, Matthew Cabe, our CEO there, told his leadership team to take the time to play with GPT-5 and other tools. He wasn't asking them to replace themselves with AI agents, but to develop familiarity and practice so they can lead effectively.

What is Michelin's long-term vision in the mobility ecosystem?



Yves Caseau: I'll start with what we know. We want to master digital twin simulation, so we can invent sustainable mobility. Today, we can make tires with 30% recycled materials. We also know how to make them with 50%. The goal is to move closer to 100%, and to do that we need new materials, new processes, and new designs. The role of IS/IT is to support this with more powerful GPUs [graphics processing units], better tools, and new techniques.

The second clear thing is that the market is moving extremely fast, so we need to be more adaptive. Historically, Michelin has optimized unit costs at the expense of flexibility. We were particularly good at producing 10,000 identical tires, but the challenge is: What if you need to change every 200 tires? That's where AI, robotics, and automation can help.

The third point is about our position in the market. Our tires are high-quality, but we are seen as expensive. That's fine for the premium segment, but we also need to offer tier-2 and maybe tier-3 tires. Otherwise, we risk becoming a niche

supplier. Tire manufacturing is a volume business, and if we lose that, we'll be in trouble.

So, we've been working to improve our game as an intelligent, software-driven manufacturing company. In the past, we might have just bought software from outside. Today, we still work with partners like Capgemini, but we also want to own our destiny. We have to become good at designing manufacturing software and software for manufacturing. That is a clear strategic goal.

We're not trying to become the global software platform, but if we want to capture more of the value chain, we need to deliver more value through services. Michelin's strategy is threefold: tires, services around tires, and advanced materials. Today, services account for about one billion out of thirty, and we want to grow that. But that can only happen if we become a leader in the software market.

Yves Caseau
Group Chief Digital and Information Officer, Michelin

"If I look at where AI is bringing the most value today, it's in manufacturing. We're improving electricity consumption, reducing waste, and optimizing processes"

DAVID KNOTT

CHIEF TECHNOLOGY OFFICER

UK Government

TECHNOLOGY AND THE PUBLIC SECTOR

David is a technology leader, strategist and architect with over 35 years experience across a range of industries, including banking, insurance, transportation, utilities and media. David holds a PhD in Philosophy, specialising in Ethics. In recent years, he has applied this expertise in the fields of AI and data ethics, helping HSBC define its first set of ethical principles for the use of AI and data, and working as part of the Responsible AI teams at HSBC, Google and BCG.

Can you tell us about your current role and responsibilities as the UK Government's CTO?

David Knott: My job is to make sure that we do technology well. By that, I mean delivering better outcomes for citizens through improved systems, data, and infrastructure.

I sit within the **Government Digital Service (GDS)**, which is part of the **Department for Science, Innovation and Technology (DSIT)**. My role cuts across four main areas. First, there's **architecture:** how to steer departments toward better technology choices. Second, we lead on **engineering standards** and best practices. Third is **security and resilience**, making sure our digital services are robust and secure against external threats. Finally, we contribute to **commercial strategy,** looking at how we engage suppliers and stimulate innovation in the digital marketplace.

We focus a lot on transformation, not just in terms of new services, but also by modernizing existing systems. Technology isn't background noise, it's foundational.

David Knott,
Chief Technology Officer of the UK Government

Where do you see technology making the biggest impact in the public sector?

David Knott: There are **four major areas** where technology is making a difference.

First is **citizen services**. The public expects services that are digital, convenient, and reliable. Technology is how we meet those expectations at scale.

Second is **productivity**. We want to help public servants concentrate on value-adding work. If we can automate the routine stuff, then teachers, police officers, nurses, and civil servants can focus on what really matters.

Third, there's **specialist capability**. AI and digital tools are helping in areas such as criminal justice, healthcare, and education. For instance, they can identify patterns in data or diagnose medical conditions earlier than humans, in some cases.

The fourth area is what I call **"language in, language out."** A lot of interactions with government involve people describing their situations in everyday language and then expecting a clear response. Think of applying for a benefit or registering a complaint. Historically, computers have struggled with natural language. But with the advent of large language models [LLMs] and generative AI, we can now start meeting citizens on their terms. For me, this is genuinely exciting. Instead of forcing people to work in "machine-friendly" ways, we're teaching machines to work in people-friendly ways.

> **"With the advent of large language models and generative AI, we can now start meeting citizens on their terms"**

What do you think the public sector can learn from the private sector – and vice versa – when it comes to digital transformation?

David Knott: There's a lot to learn in both directions.
From the **private sector**, we can learn about **joined-up strategy and execution.** In large corporations, leadership can make decisions that hundreds of teams act upon. In government, we're more fragmented. Every department, school, and NHS trust has its own remit. That autonomy is valuable, but it makes it harder to share things such as infrastructure or platforms.

Private companies also often move faster when it comes to **shared services** and cloud adoption. They invest in **engineering maturity** and modern tooling that the public sector is still catching up on.

That said, there's something deeply admirable in the public sector: **purpose.** People in government are **mission-driven.** They care deeply about the impact of their work.

FROM THE PRIVATE SECTOR, WE CAN LEARN ABOUT JOINED-UP STRATEGY AND EXECUTION

What are some unique challenges you face in leading technology for government?

David Knott: There are a few that stand out.
The first is **public visibility**. When something fails in government, it fails in public. That raises the stakes and makes people more risk-averse. This is understandable but can delay progress.

The second is **structural complexity**. Unlike a single organization, government is a constellation of institutions, each with its own priorities and tech stacks. Achieving alignment takes a lot of listening and a lot of collaboration.

The third challenge is **talent.** We're in a competitive market and we still can't always match private-sector salaries. So, we rely heavily on our ability to offer meaningful work. And honestly, that works. I've seen some of the best engineers choose to work here because they believe in the mission.

Lastly, the **scale and scope** of what we do is massive. No private company engages with such a wide range of domains, from agriculture, to justice, to education, to counterterrorism.

> "I've seen some of the best engineers choose to work here because they believe in the mission"

Are there any major opportunities for value creation you see on the horizon?

David Knott: Definitely. Our State of Digital Government report estimates that we could **unlock £45 billion of value** through better digital and data practices. That breaks down into three main areas:

1. **Productivity and efficiency** – automating processes and freeing people from routine tasks.
2. **Channel shift** – encouraging citizens to use digital channels instead of phone or face-to-face, cutting cost and employee time.
3. **Reducing fraud and error** – saving money and building trust.

> "We could unlock £45 billion of value through better digital and data practices"

A lot of this comes down to modernizing systems, improving data quality, and building digital services that people want to use.

How is your team tackling long-term transformation and digital maturity?

David Knott: We've published a blueprint called A Modern Digital Government, which lays out six key priorities:

1. **Joined-up public services –** so users can navigate government without needing to know how it's organized internally
2. **Responsible adoption of AI –** making sure we use emerging technologies ethically and effectively
3. **Strengthening core infrastructure –** tackling legacy systems and investing in resilience
4. **Driving value from procurement –** aligning our supplier spend with national outcomes
5. **Investing in people –** both in terms of digital skills and leadership
6. **Transparency and accountability –** being open about what we're doing and how well we're doing it

AI AND PUBLIC SERVICES

How is the UK government implementing AI in public services?

David Knott: There are four strands, all designed to move us from early experimentation to scalable, responsible deployment.

First, we've built what we call an **AI Incubator** or **i.AI**, which is a team of deep-tech specialists who work alongside departments to apply AI in practical, impactful ways. This helps overcome one of the biggest challenges in government: limited in-house expertise.

Second, we're embedding **AI into transformation planning**. So, instead of AI being a side project, it becomes a key enabler of wider operational and service improvements. That means funding AI where it makes real-world impact – in health, education, justice, etc.

Third, we're working on **skills and confidence building.** A lot of public servants are still unfamiliar with how AI works, what it can do, and the risks it entails. So, we're rolling out training programs across the civil service to help everyone from frontline staff to policy leads build digital confidence.

And fourth, we published the **AI Playbook for Government,** on which I led. It's a practical guide that connects the technical, legal, and ethical aspects of AI use. We wanted a practical aid to help teams safely deploy AI while complying with laws and upholding key principles such as fairness, transparency, and privacy.

WE'RE EMBEDDING AI INTO TRANSFORMATION PLANNING

What excites you most about the current AI landscape in government?

David Knott: What's exciting is that we're seeing real, applied use cases, not just hype. We're at a point where AI can genuinely **change how work gets done** on the front line of public services.

Let's take a simple example. If an AI assistant can save someone half an hour a day by drafting emails or summarizing documents, that's significant. It's not just saving money, it's giving a teacher 30 more minutes to work with students, or a police officer more time to investigate a case. That's a productivity gain with purpose.

The paradigm shift in how computers operate is also incredibly exciting to me. Traditionally, we programmed systems using logic: "if X, then Y." But machine learning [ML] does things computers previously couldn't, like make judgments or interpret language. That opens up all kinds of new possibilities for government.

How is AI being applied inside government?

David Knott: I think it helps to break it into **four categories**, each with different challenges and benefits.

First, there's **embedded AI**. Features like smart suggestions or predictive text are built into everyday tools. For most users, this will be the most common experience. The tools change subtly, and the way we work has to shift with them. It's more about change management than system development.

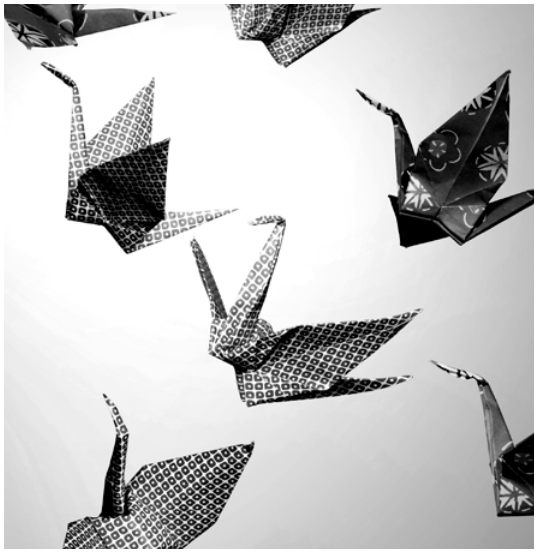
Second, we're seeing AI **used within custom-built solutions.** Instead of

"We're at a point where AI can genuinely change how work gets done on the front line of public services"

traditional coding, teams are embedding AI models into software. For example, using ML rather than a hard-coded rules engine to decide eligibility for a service. This requires careful engineering, testing, and ongoing maintenance.

Third, AI is transforming **how we build software itself.** Tools such as GitHub Copilot help developers write code faster and better. But they also raise new questions: How do we test AI-generated code? How do we maintain it? These are challenges we're actively exploring.

The fourth category is the most forward-looking: **agentic AI**. These are AI systems that can act on behalf of a user – for example, by booking appointments or submitting forms. That brings up important questions around **identity, trust, and authorization.** If an AI claims to be acting on someone's behalf, how do you know it's legitimate? And what limits do you place on its authority? We'll need new protocols for that.



> **If an AI claims to be acting on someone's behalf, how do you know it's legitimate?"**

How important is data in making AI work within government?

David Knott: Data is **foundational,** and it's also one of our toughest challenges. Government has a vast amount of data, but it's fragmented across systems and formats. Some of it is highly sensitive. Some of it is underused. We've tried every model: data warehouses, data lakes, data meshes. And while we've learned a lot, we haven't cracked the problem.

The emerging concept of **data fabrics** is promising. It allows data to stay where it is, while making it discoverable and usable through common governance and metadata. That's the direction we're leaning into.

We've also launched the **National Data Library**, which is about making data available for training and research, while ensuring we meet standards around consent, privacy, and transparency. Getting this balance right between utility and ethics is crucial to developing responsible AI.

WE'VE TRIED EVERY MODEL: DATA WAREHOUSES, DATA LAKES, DATA MESHES. AND WHILE WE'VE LEARNED A LOT, WE HAVEN'T CRACKED THE PROBLEM

Many systems in government are still legacy-based. How are you tackling modernization?

David Knott: Modernization is essential to stability, security, and progress. Legacy systems are a major barrier. In fact, our recent ***State of Digital Government*** report showed that the number of critical legacy systems has gone up, not down. That's worrying, and it's a call to action.

We're working hard to **make the case for investment.** It's not just about cost savings. It's also about reducing service outages and risks to the public. If a citizen can't access their benefit because of a system failure, that's not just a technical issue, it's also a human one.

We're also focused on **designing secure systems.** That's why we've published our Secure by Design standard. Security needs to be baked in from day one. This is part of our broader push for digital maturity across departments.

> "The number of critical legacy systems has gone up, not down. That's worrying, and it's a call to action"

BUILDING RESPONSIBLE AI

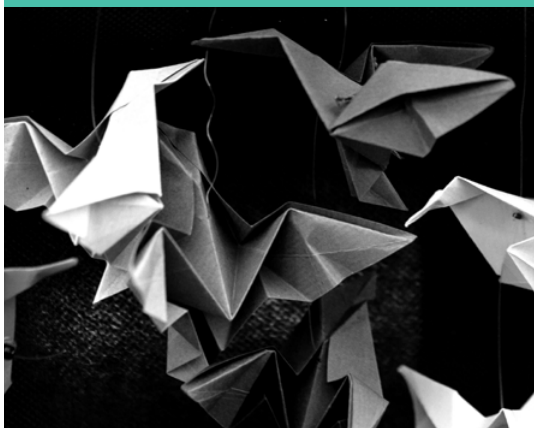
How do you think about ethics in technology?

David Knott: I have a PhD in Philosophy, so ethics has always been part of my thinking. But for a long time, I kept that separate from my work in technology. That's no longer possible.

AI raises real ethical questions. It affects real people. When we're building models or deploying systems, we need to remember this isn't abstract. The data we use represents human lives. The decisions we make have consequences.
My advice is: don't overcomplicate it, but don't ignore it either. You don't need a philosophy degree to know what's right and wrong. But you do need to **ask the questions**, involve diverse voices, and build governance structures that support good decision-making.

We also need to move beyond **tick-box compliance.** Ethics isn't a checklist. It's a conversation, a discipline of constantly asking: "Is this the right thing to do?"

"Ethics isn't a checklist. It's aconversation, a discipline of constantly asking: "Is this the right thing to do?"



SECURING PUBLIC DATA

How is the UK government strengthening digital resilience in the face of growing cyber threats?

David Knott: We're making progress, but digital resilience remains a big challenge. That's not just my view. It's backed by data from the ***State of Digital Government*** report and the National Audit Office.

The Government Security Group has developed and rolled out a framework called **GovAssure**. It's essentially a structured approach that allows departments to self-assess and be assessed independently against core standards for cybersecurity and operational resilience. It brings **visibility and accountability.** It helps us understand where the gaps are and where we need to act.

But resilience doesn't come just from undergoing assessments. That's why we also developed our **Secure by Design** standard. It means engineers and developers, not just security specialists, receive clear guidance on how to build resilient systems.

We also have the huge advantage of working closely with the **National Cyber Security Centre (NCSC).** They give us world-class research, early warnings on threats, and deep expertise. That partnership lets us stay ahead of risks in ways that many private-sector organizations can't.

Is the government preparing for the era of quantum computing and post-quantum cryptography?

David Knott: Yes, very much so. We're now looking at a **10-year horizon** for post-quantum readiness, and we know that the cryptographic methods we use today may not survive that transition.

We recently co-published an **international position paper** that lays out our strategic posture for post-quantum security. It's about building **algorithmic agility** into our systems, so, unlike most legacy systems, we can respond to evolving threats.

It's not just a technical shift. It's a **capability-building challenge.** We need systems that can evolve and people who can manage that evolution

WE'RE NOW LOOKING AT A 10-YEAR HORIZON FOR POST-QUANTUM READINESS

Being part of the **DSIT** gives us another edge. We're aligned with the UK's national quantum strategy, which includes some of the most ambitious quantum research programs in the world, such as the **National Quantum Computing Centre [NQCC]**. Through those partnerships, we're connecting policymakers and digital leaders across government with the front lines of quantum innovation.
Quantum won't solve every problem, but there are many areas of government services where it can help.

How do you see generative AI [Gen AI] reshaping the cybersecurity landscape?

David Knott: AI and cybersecurity are a natural match. At its core, cybersecurity is about **detecting patterns –anomalies**, changes in behavior, indicators of compromise. That's exactly where AI thrives.
We've used ML for anomaly detection for a while now. But **Gen AI brings new capabilities**, especially in language-based analysis. For example, it can help us identify **prompt injection attacks,** where someone tries to manipulate an AI system by feeding it malicious input. It can also enhance phishing detection, which is important as AI is making phishing emails more sophisticated.
Gen AI lets attackers **scale and personalize** their attacks. So, we must use the same tech to **identify subtle threats and understand intent.**
It's a bit of an arms race. But I'm confident that, with the right governance, and with the partnerships we have, we can stay ahead.

Looking back on your career, which leadership lessons have you learned?

David Knott: First, **technologists belong in the boardroom.** Early in my career, I saw how much better decisions were when technology leaders had a seat at the table. Technology isn't a support function anymore, it drives the mission. So, my advice to fellow tech leaders is: don't wait to be invited into the room. Be bold. Bring your voice.

> "Technologists belong in theboardroom"

Second, **delivery is, by nature, unpredictable.** If you're doing something meaningful, it usually means you're doing something new. That means there will be unknowns. Agile, DevOps, and Site Reliability Engineering (SRE) aren't just buzzwords, they're toolsets to navigate that unpredictability. The idea that you can plan out every detail in a five-year waterfall strategy is fiction. We need to embrace uncertainty and learn to "feel" our way forward by learning in real time.

Third – and this one's increasingly important – **business leaders must understand how tech works**. It's no longer safe to just rely on what vendors say or what a glossy demo shows. You don't need to be a developer, but you do need a working understanding of the tech. My role is often to "demystify the magic," to help leaders make informed decisions based on what these systems can and can't do.

> **Business leaders must understand how tech works"**

What do you think will define the next decade of technology in government?

David Knott: Three trends come to mind.

First, **AI will keep growing but the focus will shift to application.** The research arms race for the biggest models will continue, but what will matter most is how those models are applied. We're already seeing the rise of agentic AI – systems that don't just respond but act with initiative. That's where questions of trust, identity, and authorization will become central.

Second, **quantum readiness**. It won't be a dramatic arrival, but it's coming. We'll need to build new skillsets in quantum engineering and designing quantum algorithms. We'll need development tools to make that accessible. It reminds me of the early days of computing, when the barrier to entry was high. That will change, but we must start investing in it now.

And third, **a deep rethinking of digital trust.** We're realizing that the internet, as it was originally designed, didn't build in enough trust, security, or identity controls, such as **verifiable credentials, user-controlled identity,** and **transparent authorization**. We're trying to retrofit those now. Web3 hasn't delivered on all its promises, but it has introduced useful ideas.

David Knott
Chief Technology Officer
UK Government

"AI will keep growing but the focus will shift to application"

CORENCE KLOP

CISO

Rabobank

HARNESSING AI FOR CYBER RESILIENCE

Corence Klop holds almost 20 years of experience within Rabobank with leading roles in the areas of digital transformation, innovation and data & analytics. In her current role, as Chief Information Security Officer, Corence is responsible for setting the information security vision, strategy and priorities, develop and maintain the information security standards and frameworks, and representing Rabobank in matters of resilience within The Netherlands.

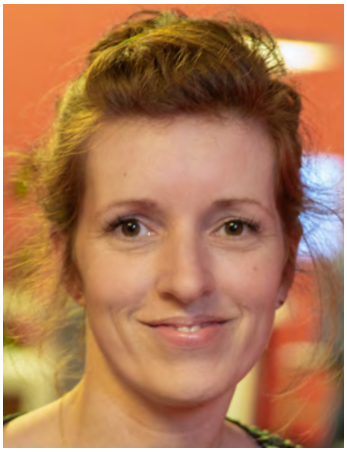
She also works as a non-executive board member of the Rabobank Pension fund and member of the supervisory board of a library.

Can you walk us through your journey at Rabobank and your current responsibilities as CISO?

Corence Klop: I stepped into the role of CISO at Rabobank in September 2023. In this position, I hold global and group-level responsibility for the security of the bank. This includes our central operations, as well as regional branches and subsidiaries. It's a role that comes with immense accountability. If something goes wrong, the buck stops with me. But it also gives me the freedom to shape the bank's strategic agenda for change.

Prior to this, I spent three years in the bank's data and analytics division. I led, for example, a community of 600–700 professionals focused on data and analytics – a key area of expertise within the organization. My interest lies in analytics and uncovering ways to extract value through actionable insights.

I have a background in innovation management, which fuels my passion for emerging technologies. I'm constantly on the lookout for new tools and techniques that can help us stay ahead, particularly in security and operational resilience.



Corence Klop
CISO
Rabobank

"Security isn't just about preventing risk – it's also about creating the greatest value for your organization and our customers"

Do you find there is friction between creating value with data and protecting it?

Corence Klop: There is friction, but I think it partly comes from my personality. I'm opportunistic, always thinking about what can be done with data or certain technologies. At the same time, working in security means a strong focus on protecting privacy and assets and ringfencing sensitive data. Both aspects are important. Security isn't just about preventing risk – it's also about creating the greatest value for your organization and our customers.

THE SURGE IN CYBERATTACKS

Since assuming leadership, have you noticed a rise in the number and nature of cyberattacks?

Corence Klop: The increase has been exponential. In the first half of 2025 there has been a major increase in distributed denial of service (DDoS) attacks. March 2025 saw more denial requests than entire 2024. Financial Services is the most frequently attacked industry (34% of all global attacks). In Q1 2025, we have seen more than 250k phishing attacks against Rabobank. That's a staggering number and testament to how aggressive the threat landscape has become.

> "In Q1 2025, we have seen more than 250k phishing attacks against Rabobank"

The attack maturity is also increasing, which has massive operational implications. We are talking about phishing, QR code scams, man-in-the-middle attacks and, increasingly, deepfake-based threats. What's more concerning is that this trend is not plateauing. Rather, it's escalating.

That's why technologies such as AI are not just a strategic advantage, they're a necessity. With threats increasing both in volume and sophistication, we need smarter, more scalable solutions to prevent and respond and to stay resilient.

TECHNOLOGIES SUCH AS AI ARE NOT JUST A STRATEGIC ADVANTAGE, THEY'RE A NECESSITY

What do you see as the primary drivers of this surge in cyber threats?

Corence Klop: A major factor is the volatile geopolitical environment. These dynamics have real consequences on the cyber landscape.

Nation-state actors and politically motivated threat groups are becoming more active. And even beyond state-driven actions, the general level of criminal sophistication has risen. Bad actors are evolving fast. They're using AI themselves now. It's no longer just lone hackers or small-time phishing scammers; there's a whole ecosystem behind this.

Could you expand on the evolution of phishing and how attackers are adapting their methods?

Corence Klop: Phishing remains one of the most persistent and effective forms of attack, but it's evolving. It's no longer just about fake emails with suspicious links. Phishing kits have added AI integration to simplify the process to build multi-language tailored phishing pages delivering much more sophisticated results.

> "Deepfakes are entering the equation. Imagine receiving a video call or voicemail from someone who looks and sounds exactly like your boss, asking you to approve a financial transaction urgently"

Perhaps more alarmingly, deepfakes are entering the equation. Imagine receiving a video call or voicemail from someone who looks and sounds exactly like your boss, asking you to approve a financial transaction urgently. Deepfake continues to be on the rise. Threat actors increasingly offer deepfake services claiming to be able to circumvent Know-Your-Customer protocols.

This evolution of threats makes it clear that conventional security measures are no longer sufficient. Attackers are using emerging technologies, and we need to keep up.

KEEPING UP WITH THE THREAT ENVIRONMENT

With such advanced threats, how is Rabobank preparing for the future?

Corence Klop: Security is a core capability. We have an information security strategy with a solid foundation to defend against most future threats.

The sheer volume of attacks means we need systems that can prioritize, detect, and respond, often autonomously. This is where AI and automation come in. For example, automating the triage of security alerts can save thousands of hours of analyst time and ensure critical incidents are caught early.

"Automating the triage of security alerts can save thousands of hours of analyst time and ensure critical incidents are caught early"

Beyond that, the people and process part of our strategy are very important. All employees have a role to play and should have a minimum level of security maturity so they know how to behave in a secure way. Security is not the job of one department. It's embedded in our IT, operations, and customer-facing units. Everyone has a role to play.

We are not alone in this. We actively join forces with other major organizations in the Netherlands by sharing our experiences and knowledge, to stay prepared for future challenges.

How do you align that long-term security view with agile ways of working?

Corence Klop: As mentioned in our security strategy, we've defined a Foundation, which includes all essential security measures. But beyond that, we also prepare for emerging technologies such as AI and quantum computing.

Our strategy is translated into yearly priorities. Of course, we cover the basics that every organization needs, but we also explore how to prepare for developments that may arise in two or three years. I try to strike a balance in ensuring we have the technology we need today, while building for the future.

"Post-quantum cryptography — it might not be an imminent risk, but we know it's coming"

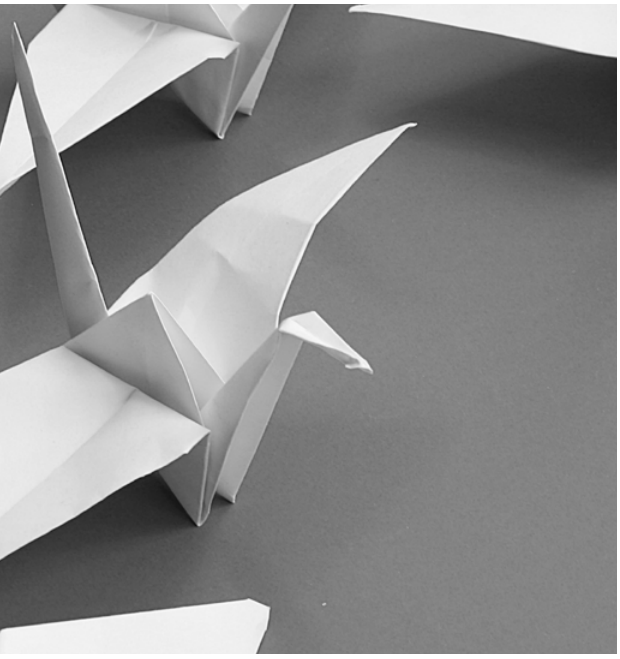
A good example is post-quantum cryptography. It might not be an imminent risk, but we know it's coming. I push for topics like that to be included in our priorities. That means starting with an inventory of what we currently have, building internal expertise, and embedding these topics in the organization's agenda.

AI AND CYBERSECURITY

In your view, where does AI – and specifically generative AI (Gen AI) – hold the most immediate potential in cybersecurity operations?

Corence Klop: In the short term, I believe the greatest potential for AI and Gen AI, lies within the security operations center (SOC). The SOC deals with a massive volume of alerts daily, and that's precisely where Gen AI can be a game-changer.

One key use case is assisting analysts during the alert investigation process. Gen AI can streamline their workflows by quickly searching across multiple databases and offering recommendations for action. It essentially acts as an advisor, advising whether to escalate an alert, ignore it, or take specific action.



What approach are you taking to improve detection and response?

Corence Klop: Since we didn't find a reliable off-the-shelf solution, we've started building our own ML model specifically trained on our own data.

The advantage here is twofold. First, we control the dataset, which means we can fine-tune the model to our environment and threat landscape. Second, it allows us to embed domain knowledge directly into the model, which generic solutions struggle to do.

It's still early days, but the results are promising. We can work better with high volume data sources and can better detect.

What are some of the challenges you've faced in building AI models for in-house cybersecurity?

Corence Klop: One of the first challenges we encountered was the expertise gap. In cybersecurity, we traditionally don't have data scientists embedded in our teams. Conversely, the data science teams at our bank, while very skilled – especially in areas such as fraud detection – aren't familiar with the specifics of security data. This divide made collaboration difficult and our security team had to start learning the principles of AI.

Another major issue was tooling. Many of the standard tools we use in security, like Microsoft Defender, aren't designed to handle large datasets or ML. You can't just run Python or complex queries on these platforms. So, we needed an updated infrastructure to run and train models efficiently, which could handle the scale of data we were working with.

As you're building AI models internally, how do you handle ethical concerns like explainability, transparency, and bias?

Corence Klop: Our analytics teams follow a structured AI Way of Working (WoW) that guides them through every step of model development. The AI WoW ensures AI risk minimization and AI value maximization including ethical considerations. It emphasizes explainability, transparency, and documenting decisions. You can find out why a particular modeling choice was made, even years later.

At Rabobank, we make a Responsible AI building block available for teams. This is designed to be compliant and in control by translating AI related standards, guidelines and frameworks into technical components to embed in all use cases.

What advice would you give an organization just starting its AI cybersecurity journey?

Corence Klop: My first piece of advice is to get your data in order. Before you build or even adopt an AI model, you need a clean, consolidated source. Our early modeling efforts were hampered by inconsistent and incomplete datasets.

Secondly, I recommend starting with what's already available. Don't try to build everything from scratch. Run experiments with available tools, understand their capabilities and limitations, and build internal expertise along the way.

How do you balance AI tools with skill development in your team?

Corence Klop: First of all, there is a strong focus on building AI skills, not only in the security organization but in the whole organization. DataWise is a global learning program for all employees. Rapid innovations in data and AI impact our work. Data and AI help us provide excellent customer service, improve efficiency and performance, and make the right decisions. This requires continuous skill development. DataWise supports employees in this development.

Also I've experienced that security analysts are fast in learning how to design, build and deploy detection rules and models in a short timeframe.

Finally, it's about focus. AI tools will not replace a security analyst. It will augment their work. This also means you should be careful how to build up AI. The model should be validated since it should do what it's supposed to do.

> "AI tools will not replace a security analyst. It will augment their work"

A big part of cybersecurity success depends on end-user behavior. How do you manage awareness without creating fatigue?

Corence Klop: I focus on integrating attention-worthy topics into the daily routines of my users – or, in my case, colleagues – without making it feel like a burden. It's about using small, everyday moments to raise awareness.

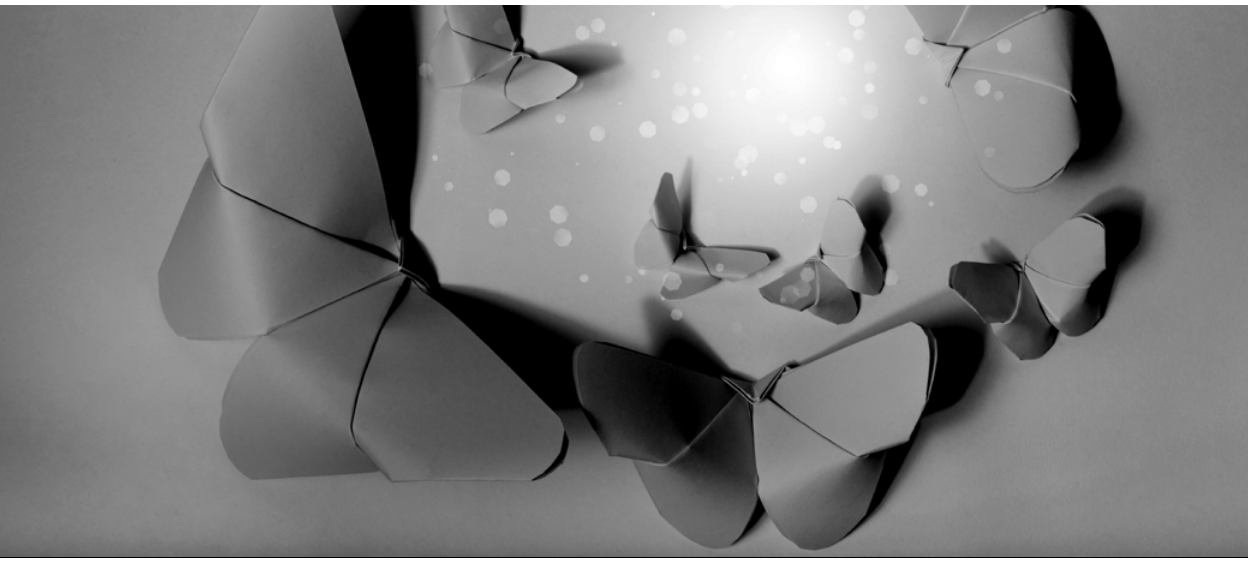
Phishing is a great example. We regularly send simulated phishing emails and monitor responses. Instead of following up with long training sessions, we provide micro learnings of one to two minutes to highlight what they could have checked, what they might have done differently, and offer additional resources to those who are interested. It's all about keeping it simple and accessible, and finding creative approaches to keep them engaged.

Which trends do you see shaping the future of AI in cybersecurity?

Corence Klop: One major factor will be talent. Finding people with the right blend of AI and cybersecurity expertise is only going to get tougher. These technologies will need to help teams do more with less.

Education is the foundation. You can have the best tools, but if your people fall for a deep-fake video or phishing attempt, those tools might never come into play. We stress critical thinking, skepticism, and adherence to process. My team works hard to keep everyone aware, not just of existing threats, but also of how they're evolving.

From a technical perspective I see a few developments: 1) Identity fraud – onboarding fake customers, 2) Attacks will be harder to detect, faster and more convincing, and 3) More and better personalization in scams.



Corence Klop
CISO
Rabobank

"Finding people with the right blend of AI and cybersecurity expertise is only going to get tougher"

DR. WALTER SUN

Head of AI

SAP

DRIVING BUSINESS VALUE WITH AI AGENTS

Dr. Walter Sun is Senior Vice President and Global Head of Artificial Intelligence at SAP. He leads a centralized AI unit that engineers AI products for implementation and reuse across SAP applications. Prior to SAP, Dr. Sun was Vice President of Copilot Applied Artificial Intelligence for business applications at Microsoft. Previously, Dr. Sun worked at BlackRock Financial Management as a quantitative portfolio analyst and at Apple Inc. as a senior software engineer and scientist.

SAP'S AI STRATEGY: THE 3RS FRAMEWORK

How is SAP integrating AI into business operations?

Dr. Walter Sun: SAP follows the "3Rs" framework to ensure AI solutions are impactful and trustworthy:

1. **Relevant –** AI must be tailored to meet business needs. We incorporate industry-specific context into our AI models. For example, a supply chain company in the US may have different requirements than one in the UK, and our AI adapts accordingly.
2. **Reliable –** AI must provide accurate, fact-based outputs. We use grounding techniques [connecting model output to verifiable sources] and provenance checks to verify AI-generated information, minimizing hallucination and maximizing accuracy.
3. **Responsible –** AI must be ethical, explainable, and compliant with regulations. Transparency is at the core of our approach, ensuring users understand the logic behind AI-driven decisions.

Dr. Walter Sun
Head of AI
SAP

WE USE GROUNDING TECHNIQUES [CONNECTING MODEL OUTPUT TO VERIFIABLE SOURCES] AND PROVENANCE CHECKS TO VERIFY AI-GENERATED INFORMATION, MINIMIZING HALLUCINATION AND MAXIMIZING ACCURACY

SAP integrates AI into three key areas:

- **Native AI integration:** AI is embedded into SAP applications like SuccessFactors for HR management, allowing users to generate job descriptions using natural language.
- **Joule AI copilot:** Joule is SAP's digital assistant, enabling users to execute tasks seamlessly across SAP applications.
- **Business Technology Platform (BTP):** Our generative AI (Gen AI) hub offers access to over 30 large language models (LLMs), allowing businesses to build and customize AI applications.

> "AI must be ethical, explainable, and compliant with regulations"

How does Joule AI – SAP's digital assistant – work?

Dr. Walter Sun: Joule is SAP's digital copilot, designed to facilitate natural language interactions across business applications. It serves as a bridge between users and various AI agents, orchestrating tasks efficiently.

For instance, if a user wants to schedule a business trip, Joule can:

1. Check both the user's calendar and those of their colleagues to find a period when all relevant parties are available.
2. Coordinate with SAP's travel platform to book flights and hotels.
3. Connect with CRM [customer relationship management] systems to notify relevant stakeholders and log the meeting.

Joule stands out from other AI agents because of its deep integration into the SAP ecosystem. It can interact across multiple SAP applications – finance, supply chain, HR, customer relations – offering a unified, AI-driven experience. Unlike standalone AI agents, Joule connects various enterprise functions, allowing organizations to streamline processes across departments.

AI ADOPTION: DRIVERS AND CHALLENGES

What are the key drivers behind businesses adopting AI and AI agents?

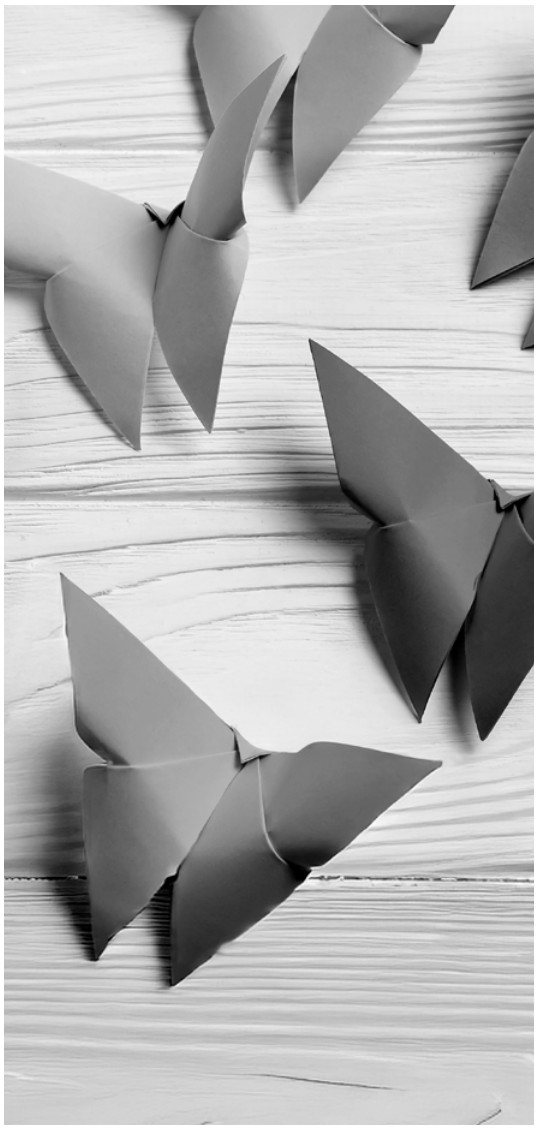
Dr. Walter Sun: The primary motivation for businesses to adopt AI is to drive efficiency and create value. Organizations want to achieve more in less time, enhance their decision-making, and automate repetitive tasks. AI technology – including AI agents – offers powerful tools to help businesses meet these objectives.

Another important factor is customer demand. End-consumers and enterprise clients expect seamless, intelligent interactions. AI can enhance customer service, personalize user experiences, and improve overall business efficiency.

But AI adoption is not just about automation. It is about staying competitive. Historically, every major technological shift has created winners and laggards. Organizations that recognized the advantages of PCs early on gained an advantage over those that stuck with typewriters. Similarly, when the internet emerged, businesses that embraced online connectivity became more efficient than those that didn't.

> **AI adoption is not just about automation. It is about staying competitive"**

AI represents another paradigm shift. Companies recognize they must integrate AI into their operations to remain competitive. They want to explore AI's potential while minimizing risks related to security and privacy.



What are some of the biggest challenges when adopting AI?

Dr. Walter Sun: Many organizations are eager to explore AI but are still in the early stages and are proceeding cautiously. One of their biggest concerns is around security and privacy. Organizations want to harness AI while protecting their data. They also want transparency on how AI models make decisions, as the key to building trust in the system. Trust is a major hurdle. Businesses need confidence in AI systems before granting them autonomy. One way to build trust is through "read-only" AI implementations, where AI provides recommendations, but humans make the final decision. Over time, as AI consistently delivers reliable results, businesses become more comfortable automating more tasks.

Data quality is another challenge. AI models rely on high-quality, structured data. Poor data leads to inaccurate AI outputs. Organizations must invest in data management and governance to maximize AI effectiveness.

Bias in AI models is also a concern. AI learns from historical data, which may contain biases. Businesses must carefully curate training data and apply bias-mitigation techniques to ensure fairness and accuracy in AI decision-making.

ONE WAY TO BUILD TRUST IS THROUGH "READ-ONLY" AI IMPLEMENTATIONS, WHERE AI PROVIDES RECOMMENDATIONS, BUT HUMANS MAKE THE FINAL DECISION

THE EVOLUTION OF AI TRUST

How do you think organizations will adapt to AI decision-making?

Dr. Walter Sun: The adoption of AI autonomy will follow the pattern of past technological shifts. When ecommerce first emerged, many people were reluctant to enter credit card information online. But over time, online shopping became the norm and, today, we rarely think twice before making digital transactions.

Similarly, businesses today supervise AI closely but, as the tech proves its reliability, organizations will gradually expand AI's role from low-risk automation to more strategic decision-making.

For example, AI-driven travel-planning systems already suggest itineraries, book flights, and reserve hotels. Initially, users may review every detail before confirming but eventually they may allow AI to manage bookings autonomously. This will be the natural progression of AI adoption across industries.

How autonomous should AI agents be, especially in critical environments like healthcare and aerospace?

Dr. Walter Sun: AI autonomy is a spectrum. Over time, as confidence grows, organizations can gradually increase AI autonomy by setting predefined thresholds. For example, if an AI agent is handling reimbursements, approvals under $100 could be processed automatically, while amounts over $10,000 might require managerial approval. This structured approach helps build trust in AI without compromising oversight.

The same principle applies to customer service. AI agents can manage standard inquiries but escalate complex cases to human representatives. Similarly, in finance, AI can validate invoices and cross-check financial data before requiring human approval for large transactions.

"As the tech proves its reliability, organizations will gradually expand AI's role from low-risk automation to more strategic decision-making"

However, in critical environments such as healthcare, aerospace, or industrial production, moving to full AI autonomy is not advisable. These fields demand rigorous validation and accountability. AI can assist by analyzing vast amounts of data, flagging anomalies, and recommending actions, but human experts must always take high-risk decisions. As AI models become more sophisticated and reliable, the balance between AI automation and human oversight will continue to evolve.

THE RISE OF MULTI-AGENT AI SYSTEMS

How do multi-agent AI systems work, and how are they transforming business processes?

Dr. Walter Sun: Multi-agent AI systems enable different AI agents to collaborate and execute complex workflows. A great example is dispute management. When a customer files a complaint about an incomplete delivery, multiple departments – finance, supply chain, and customer service – need to coordinate. Traditionally, this process could take days or even weeks.

> **AI agents communicate with each other, gather relevant data, and present a complete resolution to the customer"**

With AI-powered multi-agent systems, the workflow is streamlined:

1. A conversational AI agent interacts with the customer and logs the dispute.
2. The supply chain AI agent retrieves delivery records to verify shipment details.
3. The finance AI agent cross-checks invoices to confirm payment and refund eligibility.
4. The CRM AI agent drafts a resolution email based on company policies.

What once required extensive human coordination now happens within minutes. AI agents communicate with each other, gather relevant data, and present a complete resolution to the customer, with final approval from a human supervisor. This dramatically improves efficiency and customer satisfaction.

Q: What stage are businesses at with implementing multi-agent AI systems?

Dr. Walter Sun: Many businesses are experimenting with multi-agent AI systems in controlled environments before scaling them. At SAP, we collaborate with clients through early adopter programs to integrate multi-agent AI solutions into their workflows.

> **Many businesses are experimenting with multi-agent AI systems in controlled environments before scaling them"**

Some enterprises are testing AI-driven procurement systems where different AI agents handle supplier negotiations, contract validation, and purchase approvals. Others are deploying AI-driven HR systems that automate candidate screening, interview scheduling, and onboarding processes. The goal is to build confidence in AI before enabling full-scale automation.

As businesses gain experience with AI-driven automation, we expect broader adoption of multi-agent AI systems in industries like finance, supply chain management, and customer support.

AI INVESTMENT AND ROI EXPECTATIONS

What level of investment is required to implement AI agents?

Dr. Walter Sun: Investment in AI depends on organizational size and existing infrastructure. Large organizations with dedicated data science teams can develop custom AI solutions, while mid-sized organizations often use SaaS [software-as-a-service]-based AI platforms, such as SAP's Joule AI, for faster deployment.

For most businesses, the investment includes:

- AI software and platform subscriptions
- Integration with existing enterprise systems
- Employee training on AI-powered workflows

ROI varies depending on use cases. Organizations that deploy AI for high-volume tasks, such as dispute resolution or financial reconciliation, often see rapid ROI. For example, if AI-driven automation enables an organization to double its customer service capacity without additional staffing, the efficiency gains quickly outweigh the initial investment.

In many cases, organizations recover AI investment within months, especially when AI-driven automation leads to measurable improvements in productivity and service quality.

IN MANY CASES, ORGANIZATIONS RECOVER AI INVESTMENT WITHIN MONTHS

SUSTAINABILITY AND AI: MANAGING THE CARBON FOOTPRINT

How can organizations mitigate AI's environmental impact?

Dr. Walter Sun: Sustainability is an important consideration in adoption of AI. At SAP, we provide a Sustainability Control Tower that helps organizations visualize their carbon footprint and take corrective actions. AI can help identify inefficiencies, such as offices that leave lights on overnight or use excessive air conditioning, by analyzing energy consumption data and providing insights upon which management can act.

Additionally, SAP's Generative AI Hub supports multiple LLMs with an abstraction layer that optimizes both cost and energy consumption. Not all AI tasks require the most powerful models. For simple customer inquiries, a lightweight AI model can be used instead of a high-compute model like GPT-4. By selecting the most efficient model for each task, businesses can reduce energy consumption and improve cost-effectiveness while maintaining AI performance.

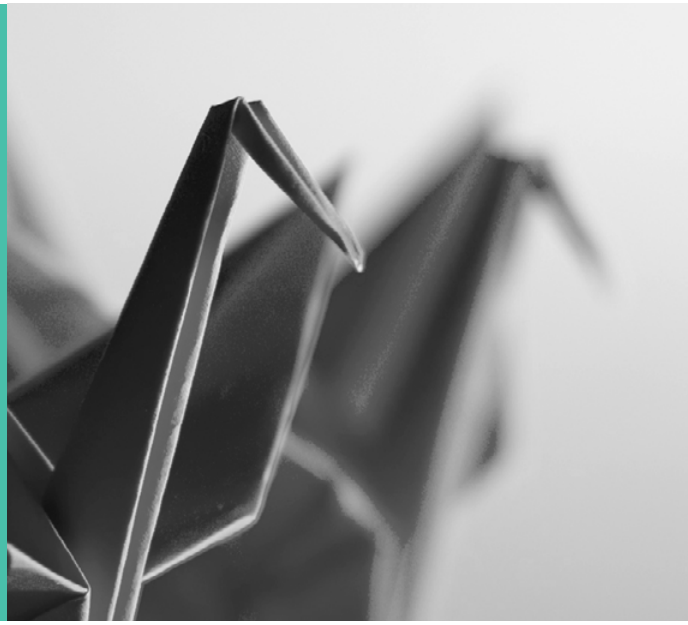
LOOKING FORWARD

How do you see AI agents collaborating with human teams?

Dr. Walter Sun: AI is not here to replace humans but to augment human capabilities.

As AI technology advances, we may see hybrid teams where AI agents take on more operational responsibilities, while humans focus on strategic decision-making. AI assistants will become integral to daily workflows, coordinating schedules, drafting reports, and optimizing business processes.

"By selecting the most efficient model for each task, businesses can reduce energy consumption"



Will IT departments transform into HR departments for AI agents, as Jensen Huang [CEO of NVIDIA] recently suggested?

Dr. Walter Sun: While AI agents will play a larger role in business operations, IT departments will not disappear. Rather, IT teams will evolve to manage AI-driven workflows, ensuring AI models are properly integrated and aligned with business needs. Similarly, HR departments will need to train employees on AI tools and develop new roles focused on AI oversight and governance.

HR DEPARTMENTS WILL NEED TO TRAIN EMPLOYEES ON AI TOOLS AND DEVELOP NEW ROLES FOCUSED ON AI OVERSIGHT AND GOVERNANCE

A historical comparison is the development of the role of librarians. Before search engines, librarians helped people find information manually. With the rise of the internet, their role shifted to teaching users how to navigate online resources effectively. Similarly, professionals in IT and HR will upskill to manage AI-driven processes, ensuring AI is used effectively and ethically.

How will AI agents evolve over the next three to five years?

Dr. Walter Sun: AI agents are becoming more personalized. Initially, AI models were trained on broad datasets, making them general-purpose assistants. Now, we're moving toward industry-specific AI models tailored for fields like finance, supply chain, and healthcare.

> "AI agents are becoming more personalized"

The next evolution is personal AI agents that understand individual preferences and workflows. Imagine an AI assistant that knows your preferred airlines for business trips, prioritizes your emails based on urgency, and summarizes key updates from global markets before your morning meetings. This level of personalization will transform productivity, making AI indispensable.

Dr. Walter Sun
Head of AI
SAP

"AI is not here to replace humans but to augment human capabilities"

JEREMY UTLEY

Professor of AI and Design Thinking

Stanford University

CREATIVITY IN THE AGE OF AI

Jeremy is Adjunct Professor of AI and Design Thinking at Stanford University. He is also a General Partner at Freespin Capital, a venture capital firm. With his Stanford colleague, Perry Klebahn, he co-authored ***Ideaflow: The Only Business Metric That Matters*** *(2022). For over 12 years, he served as the Director of Executive Education at Stanford's renowned Hasso Plattner Institute of Design ("the d.school"), where nearly one million students of innovation worldwide took his courses. He's the host of the* ***Paint & Pipette: The Art & Science of Innovation*** *podcast, and co-host of the* ***Beyond the Prompt*** *podcast. His current research focuses on helping individuals and organizations accelerate their comfort and confidence in using generative AI (Gen AI).*

CREATIVITY IS AN INHERENT HUMAN QUALITY, WHICH EVERYONE SHARES

UNDERSTANDING CREATIVITY

Which aspects of creativity do you think are most misunderstood?

Jeremy Utley: The biggest myth about creativity is that it's a rare gift, possessed by only a select few. Creativity is an inherent human quality, which everyone shares. But some people practice using their creative faculties, while others do not. It's just like any other skill or muscle. It can be developed, strengthened, and refined through practice.

Jeremy Utley
Professor of AI and Design Thinking
Stanford University

Can AI nurture creativity?

Jeremy Utley: Absolutely. AI can be a coach for almost anything. Need help with your golf swing? It can be a golf-swing coach. Self-esteem? It can help there, too. Creativity? Of course, it can be a creative coach. The key is realizing that, if you give an AI model a specific persona – a creativity expert, say – and then ask it

to evaluate an idea, it can provide meaningful feedback that pushes your thinking, as well as generate alternative suggestions.

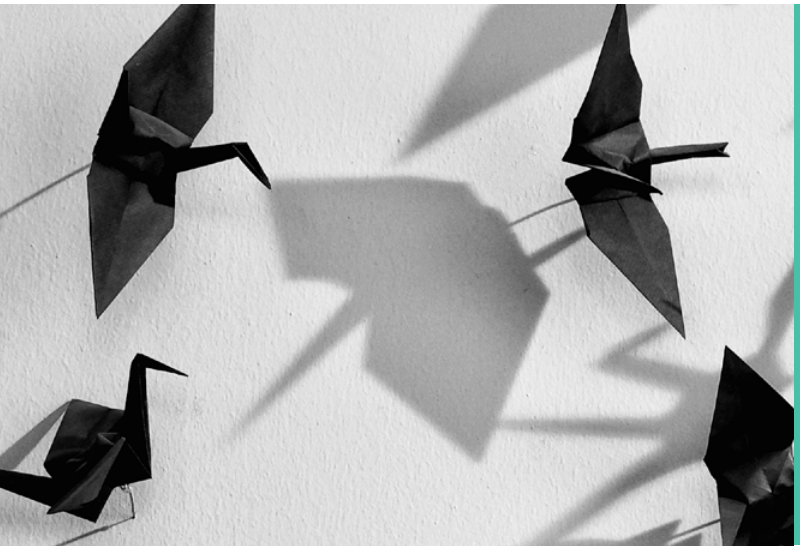
That's not fundamentally different from what we might expect from, say, a negotiation coach or a design strategist. It's a tool with vast capabilities – if you ask the right questions.

How would you define creativity in this AI-augmented world?

Jeremy Utley: One of my favorite definitions of creativity came from a seventh-grader in Ohio. Her teacher asked: "What is creativity?" and the girl wrote on a sticky note: "***Creativity is doing more than the first thing you think of.***" That's brilliant. From a cognitive science standpoint, it's incredibly accurate.

There's a well-documented human tendency called the "first idea bias," or what some refer to as "functional fixedness" or "cognitive closure." It means that, once we come up with some sort of solution, we often stop thinking. But there's no reason to believe the first solution is the best one. In fact, research shows that, if you think of 10 different solutions, the first is very unlikely to be the best.

This is where AI shines. If creativity is doing more than the first thing you think of, then it can push you to explore further. You can ask it, "Give me 10 other ideas," and it will keep going.



"Research shows that, if you think of 10 different solutions, the first is very unlikely to be the best"

Unlike humans, for whom ideation consumes energy, AI can generate alternatives effortlessly and quickly using analogy, lateral thinking, or combinatorial association. That's creative by definition.

Has the way in which your students approach creativity changed over the time you've been teaching?

Jeremy Utley: No. Humans are humans.

There may be new tools, new interfaces, but, fundamentally, the creative impulse is the same. What changes is how people express and channel that creativity, and how technology amplifies or limits it.

One major change is the uncertainty about the future. When I started teaching, around 15 years ago, students may not have known which specific job they would land in, but they had a pretty good idea of the range of jobs available.

Now, that's gone. Students say things like, "I don't even know what jobs are going to be there." That fundamental uncertainty is new.

So, when students ask, "How can I plan for an unstable future?" it's a completely justified question. The challenge now isn't just career planning. It's **creative planning** under uncertainty.

But in terms of their **approach to creativity**? No, I don't think it's fundamentally different.

WORKING WITH AI

Is it better to treat AI as a tool or a teammate?

Jeremy Utley: Teammate, without a doubt. It's about mindset. The way you treat a tool is fundamentally different from the way you treat a teammate. People sometimes ask me, "Should I say please and thank you to AI?" My answer is: What does it cost your humanity if you don't?

Saying please and thank you might cost a few more tokens or a few extra cents for OpenAI. But far more important is how it affects you. The way you approach the model reflects your humanity. And because the quality of your input directly influences the model's output, your tone and presence matter.

Bring your full self, your curiosity, your respect. That's the teammate approach. And it gets better results.

In one of your presentations, you touched on whether AI might increase or diminish creativity. Could you elaborate on that?

AI often helps people get to "good enough" ideas very quickly. But that's more about efficiency than creativity. Unless the human consciously pushes the model for more, they won't unlock true creativity"

Jeremy Utley: AI has enormous potential to enhance human creativity. But our empirical research suggests that this potential is largely unrealized, mostly due to human cognitive biases.

We talked earlier about the tendency to fixate on first ideas. AI often helps people get to "good enough" ideas very quickly. But that's more about efficiency than creativity. Unless the human consciously pushes the model for more, they won't unlock true creativity.

So, would you say that AI is like a mirror of the user's ability?

Jeremy Utley: That's a perfect analogy. The AI model reflects what you bring to it. If you're an HR expert, and you approach the model with expert-level thinking, you'll get an expert response. If I come to the same model knowing nothing about HR, I'll get far less valuable output.

THE AI MODEL REFLECTS WHAT YOU BRING TO IT

AI reveals things to you it won't reveal to someone else. That's why I say the model's power is in its ability to match and extend the user's thinking. It doesn't replace your creativity, it amplifies it.

Let's begin with what you said about valuing quantity over quality during idea generation. How should someone structure their workflow when using AI to maximize creative output?

Jeremy Utley: Workflow will always vary, depending on the job to be done. One of the most important things is to **pose more than one question**. Seek more than one answer. Try more than one thing. That's one of the easiest ways to crystallize the core of innovation.

Often, people are seeking to address the wrong problem. If you ask only one question, and it's the wrong one, you're stuck. But if you ask more than one, you minimize that risk. That's where the breadth of ideas emerges. And then try more than one thing, because it keeps you from evaluating too early.

> **A mindset of asking lots of questions and getting a range of answers is fundamental. AI allows us to explore widely, without huge capital or time investment"**

That mindset – of asking lots of questions and getting a range of answers – is fundamental. AI allows us to explore widely, without huge capital or time investment.

GETTING STARTED WITH AI

How can people integrate AI into their daily working lives?

Jeremy Utley: One of the exercises I recommend is going to ChatGPT (or any large language model [LLM]) and saying something like:

"Hi, ChatGPT. I'd like you to play the role of a ChatGPT adviser. I'm looking for ways to use ChatGPT in my work. Would you, as a ChatGPT adviser, please interview me about my workflows, responsibilities, and KPIs until you have enough information to make two obvious and two non-obvious recommendations. Go ahead and begin the interview now."

That simple prompt unlocks a whole experience. The model will start interviewing you about your role. And what's interesting is, it's role-independent. It works whether you're an intern, a manager, or an executive.

The AI adapts. It will understand your tasks and generate suggestions based on context. Few people think to make this kind of prompt. But, once they do, they often go, "Wait, can it also teach me this?" And yes, it can.

"Unlike tools such as Excel or PowerPoint, which can't teach you how to use them, AI can teach you how to use AI"

Unlike tools such as Excel or PowerPoint, which can't teach you how to use them, AI ***can*** teach you how to use AI. That paradigm shifts how you think about learning. You're not just using it to complete tasks. You're also discovering how to partner with it. I like to call it a "double delivery" exercise. It delivers on your current objective, and it opens the door to deeper exploration.

Are there common mistakes people make when using AI for creative purposes?

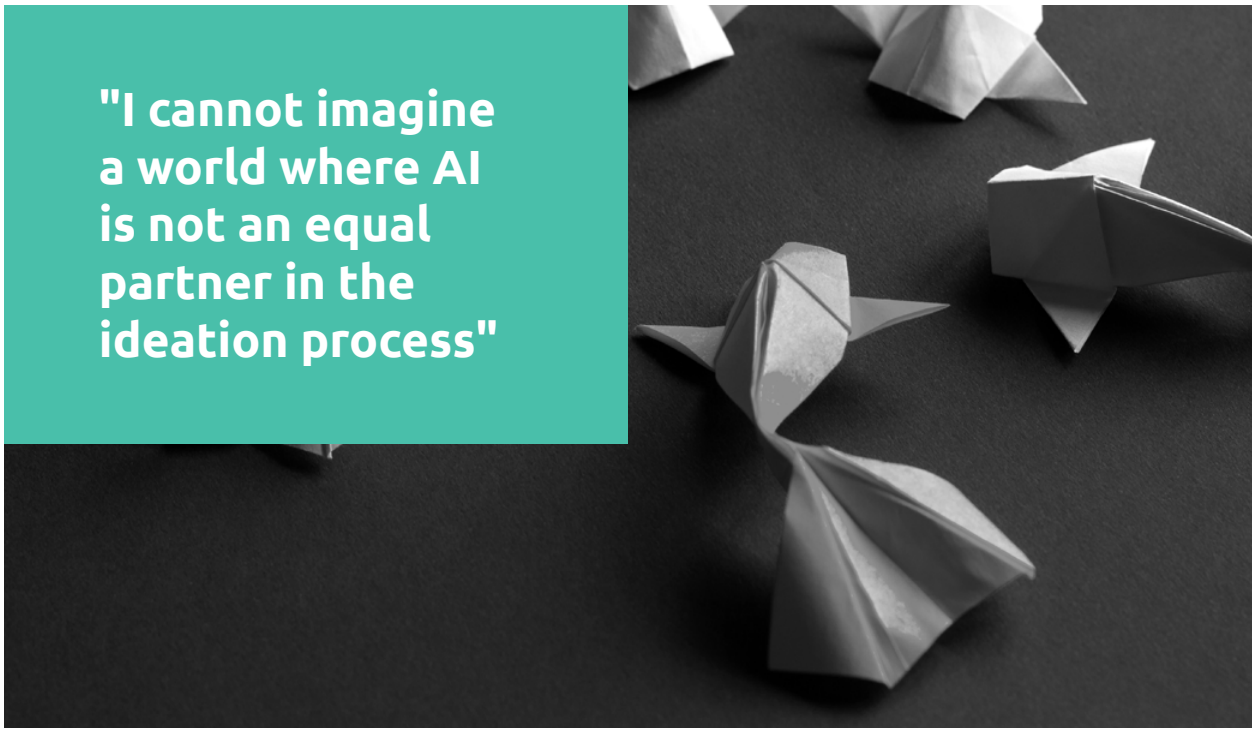
Jeremy Utley: Yes. The biggest one? People don't give enough context.

I would recommend never prompting a model without at least 400 words of context. Most people say, "My average prompt is five words." Well, that's a Google search. You should go to Google for that.

If you want to work with an LLM, treat it like you would treat a new team member. Imagine if we were starting a job together and I turned to you and said, "Make social media strategy now." That's five words. And it's absurd, right? We would never treat a human colleague that way. But we do that with AI all the time. Then it gives us a poor response, and we conclude that it's not useful. But the truth is, we ***give more context to interns*** than we do to AI. That's the mistake.

"If you want to work with an LLM, treat it like you would treat a new team member. Imagine if we were starting a job together and I turned to you and said, "Make social media strategy now." That's five words. And it's absurd, right? We would never treat a human colleague that way. But we do that with AI all the time"

You need to spend some time establishing context. What's our brand voice? What's our objective? What's the tone? Which market are we in?



LOOKING FORWARD

What does the future of ideation look like?

Jeremy Utley: I cannot imagine a world where AI is not an **equal partner** in the ideation process. It's going to sit at the table as a member of creative teams. Teams will come to see it as a creative partner, a trusted colleague who always has new ideas, who pushes your thinking, who helps you see blind spots.

If you could leave today's leaders with one mindset shift to thrive in this AI-powered world, what would it be?

Jeremy Utley: The shift is this: **You are not done learning AI. You've just begun**.

There's a human tendency to want to check off the box. "I've learned that." But when it comes to AI, that doesn't work. A portion of your attention, **for the rest of your life**, needs to be devoted to becoming a better collaborator with AI.

It's like health. You don't stay fit because you ran a marathon five years ago. You stay fit because of what you ate last week, how you slept last night, how much you moved today.

It's the same with AI. You can't say, "I took an AI course in 2023." The real question is: Have you experimented with AI in the past two weeks? Are you learning, adapting, exploring?

That's how I think about it. To stay effective, you need **continuous experimentation**. If you're not on a pathway of exploration, you're going to become obsolete.

Jeremy Utley
Professor of AI and Design Thinking
Stanford University

"A portion of your attention, for the rest of your life, needs to be devoted to becoming a better collaborator with AI"

MICHELE MOSCA

CEO

evolutionQ

BECOMING QUANTUM-SAFE

Michele Mosca is CEO and co-founder of evolutionQ, a cybersecurity company that pioneered quantum risk management and the BasejumpTM software product suite that enables scalable cryptographic resilience. Prior to co-founding evolutionQ, Michele co-founded the Institute for Quantum Computing while being a Professor of Mathematics at the University of Waterloo, Canada. He is a founding member of the Perimeter Institute for Theoretical Physics and his work on quantum computing and quantum-safe cryptography is widely cited.

Can you begin by telling us about your journey into the quantum-safe cryptography space?

Michele Mosca: I've been working at the intersection of cryptography and quantum computing since the 1990s – before the two were overtly connected. Over the past decade, I've shifted toward commercialization. Initially through services and, over the past five years, by building out a product company to address the need for cryptographic modernization, including quantum readiness and overall readiness for a cryptographic zero-day.

Michele Mosca
CEO, evolutionQ

How would you describe the current state of awareness around quantum-safe cryptography?

Michele Mosca: Awareness has definitely increased, owing in part to organizations such as Google and IBM. But we're still not where we need to be. Most people see this as a "one-problem-one-solution" situation. What they need to understand is that the quantum threat is just a visible example of

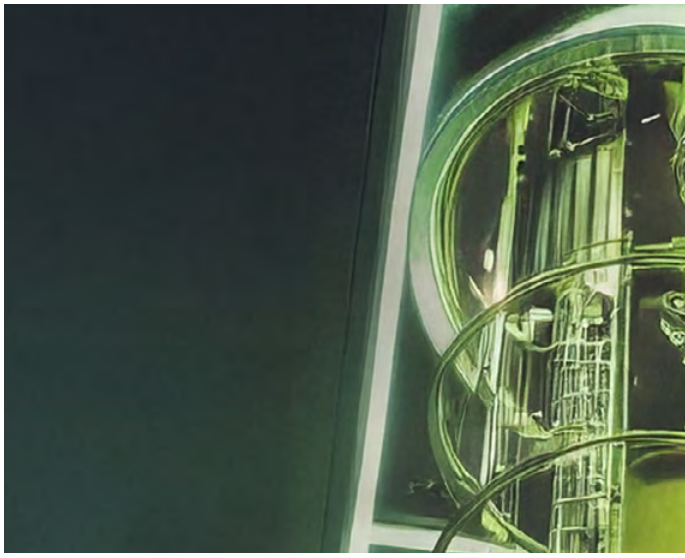
> **"The quantum threat is just a visible example of the things that could go wrong with our cryptographic foundations. We don't know the limits of quantum computing"**

the things that could go wrong with our cryptographic foundations. We don't know the limits of quantum computing and, with AI accelerating, it's becoming even more difficult to predict future vulnerabilities.

There are two waves of awareness. First, we must recognize that there is a threat. Second, and more profoundly, we have to accept that it’s not going to go away. On the contrary, code-breaking threats will keep evolving, and our systems must be resilient by design. Just as we moved from passwords to multi-factor authentication, our key exchange and cryptographic practices must also become layered and agile. But agility alone is not enough. If your infrastructure is hijacked and money is stolen, you must be resilient.

"There are two waves of awareness. First, we must recognize that there is a threat. Second, and more profoundly, we have to accept that it’s not going to go away"

> **Transitioning to quantum-safe cryptographic infrastructure is a complex, multi-year process"**



Why do you think there is an urgency to address the quantum threat?

Michele Mosca: A few key risks drive urgency. Firstly, transitioning to quantum-safe cryptographic infrastructure is a complex, multi-year process. Organizations that underestimate this challenge risk rushed, poorly executed migrations that could leave critical systems exposed and lead to prolonged operational disruption. Or they might be too late, and systemic quantum-enabled attacks start before they are ready. There's no free lunch: every unit of crypto-procrastination translates either into a unit of catastrophic risk or a unit of rushed migration risk.

Another risk is already becoming a reality: "harvest now, decrypt later" attacks. Although a cryptographically relevant quantum computer does not yet exist, malicious actors are collecting encrypted data with the intent to decrypt it once quantum computers become powerful enough to do so. If organizations fail to implement quantum-safe cryptographic strategies proactively, sensitive communications, financial transactions, and classified data may be at immediate risk.

And then, as regulators, partners, and other stakeholders push for quantum-readiness, there is compliance risk and the risk of simply not keeping up with the needs of your key stakeholders.

What are the main challenges in scaling and commercializing quantum-safe solutions?

Michele Mosca: Interestingly, the technical challenges while tough, are manageable. The harder part is getting timelines aligned across the ecosystem. Everyone from vendors to customers must commit to securing their systems by a certain date.

But some are still lagging, and we can't cater to the lowest common denominator anymore. It's time to separate the wheat from the chaff and improve our vendor ecosystem quality.

Another key issue is the lack of a clear mandate. If regulators and customers demanded resilience and set clear expectations, it would accelerate adoption. But too many are still debating when "Q-Day" will be, rather than acknowledging the urgency. That question was valid 10 years ago, but now it's outdated. Today, we need to focus on getting this done. The threat is already too close for comfort.

How do you create a sense of urgency around this threat?

Michele Mosca: Organizations need to understand that the quantum threat isn't far off in the future. It's already affecting them today, as in the "harvest now, decrypt later" threat. They must also consider the time required for a proper migration to quantum-safe technology.

This will quickly pivot from "doesn't matter" to "you better have it done." Adequate preparation will be a real business differentiator. One investor told me, "It's a dollar to get ready before left of boom, and hundreds of millions right of boom." That captures the stakes.

One of the major obstacles is self-imposed. A lot of this is driven by cool technological tactics that are unconnected with business objectives. The real goals are business continuity, resilience, trust, and risk reduction.

Why is the industry's focus on crypto inventory slowing progress, and what is the correct approach?

Michele Mosca: People are embarking on the gargantuan task of inventorying their cryptography but can't remember why they are doing it. They must use it to understand and mitigate business risk. Some even say, "I can't do my risk assessment yet because I haven't done my inventory." That's missing the point.

I'll give an example. Someone from Ericsson showed one slide in Toronto recently, it explained how 5G works and said: "The biggest threat is firmware updates." Boom. In 30 seconds, there's your biggest quantum risk. They didn't spend years scanning software just to produce massive data tables.

When cleaning your house, you don't need to dust every chandelier before you deal with the corpses in the dining room. Inventory is a part of mature crypto management, but don't let it stall your risk assessments. Act on the most obvious risks.

Have you heard of any post-migration concerns around latency, performance, or compatibility with legacy systems?

Michele Mosca: Around 80% of the time, you'll be fine. Even on a phone. But what if you're in an internet of things (IoT) scenario or other constrained environments? Then, it becomes a problem. And you better find out in advance. If you need lightweight PQC and it doesn't exist, then what?

Some experienced applied cryptographers are realizing that, most of the time, PQC is the answer. Just upgrade your PKI [public key infrastructure] to post-quantum PKI and you're good. But, in a few cases, we're seeing situations where PKI might be overkill. Here, we should revisit assumptions.

There are use cases where we did PKI because that's what we knew. But, in controlled, exclusive systems, it's worth asking why we're still using PKI. It's slow, consumes energy, and is vulnerable to cryptanalysis. In these cases, maybe it's time to leverage symmetric key solutions, which are faster and more secure in the long term.

Michele Mosca
CEO, evolutionQ

"Every unit of crypto-procrastination translates either into a unit of catastrophic risk or a unit of rushed migration risk"

Perspectives from Capgemini

THE AGE OF CONVERGENCE

Pascal Brier
Group Chief Innovation Officer, Capgemini

THE AGE OF CONVERGENCE

Pascal Brier
Group Chief Innovation Officer, Capgemini

Pascal Brier is Group Chief Innovation Officer and a member of the Global Executive Committee at Capgemini. Since 2021, he has led the Group's global Technology, Innovation & Ventures agenda, overseeing how emerging technologies are identified, explored, and applied across industries. Under his leadership, the company helps organizations harness technological progress to create new forms of business value and positive impact for society.

From technologies to systems

When the Gutenberg Bible was printed around 1455 – a masterpiece of clarity and beauty – the world changed forever. Knowledge could finally be reproduced and shared at scale. Gutenberg's genius lay not in inventing something new, but in combining existing elements: movable metal type, oil-based ink, and a screw-press adapted from wine presses. His work marked a new era through convergence, not isolation.

"We have entered an era where innovation no longer happens within technologies, but between them"

What was exceptional in the fifteenth century has now become the norm. We have entered an era where innovation no longer happens within technologies, but between them. AI learns to reason, robots to collaborate, and energy systems to think. Each breakthrough is impressive, but true power emerges when they interact: intelligence meets embodiment, computation meets physics, digital meets biological.

"Progress now depends on connecting what we have already invented"

The new frontier lies in orchestrating these convergences. How do we make technologies work together coherently, safely, and responsibly? How do we design interfaces – technical, human, and ethical – that enable this intelligence to operate across systems?

Progress now depends on connecting what we have already invented.

The new logic of innovation – From mastery to orchestration

In the twentieth century, industrial success was mainly built on the mastery of a single technology. Companies specialized and scaled around one domain: electricity, computing, telecommunications, materials, and so on. Innovation was linear: invention led to engineering, engineering led to production, which led to distribution. Competitive advantage came from depth of expertise and control over a well-defined value chain.

Today, that logic no longer holds. In the twenty-first century, value lies in connection. Disruptive innovations now emerge from the interplay: when AI meets robotics to create autonomous systems; when biology merges with computing to enable precision health and sustainable manufacturing; when new materials meet advanced energy systems to accelerate decarbonization. The frontier is now a fluid, cross-disciplinary network.

This shift transforms how organizations must think and operate. It moves innovation from R&D silos to open ecosystems, from patents to partnerships, from vertical integration to horizontal collaboration. Companies shaping the next decade will orchestrate across boundaries, linking technologies, industries, and expertise into coherent systems.

Convergence also reshapes interdependence. Industries blend into shared value networks. Humans and machines evolve toward hybrid collaboration. Public and private sectors co-architect common infrastructure – from digital platforms and shared data spaces to interconnected energy and mobility systems. Innovation, once the prerogative of a few, is now a collective act.

This transformation also challenges how public research is organized. Most institutions still reflect a logic of specialization, with labs structured by discipline. Yet today's problems rarely fit such boundaries. Designing next-generation prosthetics, for instance, requires collaboration across medicine, engineering, acoustics, computer vision, and robotics. Convergence calls for research that breaks silos, fosters multidisciplinary collaboration, and aligns inquiry with real-world complexity.

"Convergence calls for research that breaks silos, fosters multidisciplinary collaboration, and aligns inquiry with real-world complexity"

Convergence in practice

Three arenas illustrate how technologies now evolve in partnership.

First, AI and quantum computing: two revolutions increasingly intertwined. Quantum offers a new way to process information; AI provides reasoning to navigate that complexity. Together, they open new frontiers in materials science, logistics, and drug discovery. AI designs efficient quantum algorithms; quantum models accelerate AI training and optimization. This mutual reinforcement is not just computational, it signals the beginning of a new intelligence infrastructure that will redefine how we simulate, predict, and decide.

Second, humanoid robotics, driven by AI, spatial intelligence, and advanced materials. What we are witnessing, particularly in China, is a rapid migration of knowledge from adjacent industries (notably drones, autonomous vehicles, and consumer electronics) toward robotics. Companies are repurposing their expertise in sensors, batteries, and vision models to create robots that can perceive, adapt, and operate in real-world environments. The result is not only a new generation of machines, but a new industrial fabric: robots are now assembling robots.

Robots are now assembling robots

Finally, we see convergence in energy transition. The interplay between electric vehicles, battery innovation, and solar technologies is reshaping both mobility and infrastructure. Advances in one domain trigger leaps in another: better batteries enable cheaper solar storage; AI-optimized grids stabilize renewable production; circular materials science extends the lifespan of components. What were once three distinct industries are increasingly one ecosystem.

Converging away from sovereignty

Converging technologies reveal a deeper truth about technology sovereignty. As nations and companies seek control over critical technologies (chips, models, energy systems), they discover profound interdependence. The more we strive for independence, the more we uncover our interdependencies. Quantum breakthroughs rely on global semiconductor supply chains; AI depends on semiconductors, shared data, and open science; cloud relies on complex infrastructures, routers; clean energy transitions hinge on rare materials mined globally.

True sovereignty in the age of convergence will not come from isolation, nor from collaboration alone. It will depend on mastering, securing, and strategically integrating technologies that underpin interdependence. Resilience means developing know-how, talent, and infrastructure to contribute meaningfully to shared systems. Sovereignty must be redefined as the power to choose and limit dependencies: to collaborate from strength, grounded in mastery and trusted partnerships.

Leadership in a converging world

If convergence defines innovation's new logic, it also redefines leadership. The innovation model emerging today is collaborative by design. It demands not just technical mastery, but the ability to translate complexity into direction. Leadership is no longer about commanding technologies; it is about orchestrating relationships between them.

> **"Leadership is no longer about commanding technologies; it is about orchestrating relationships between them"**

From silos to ecosystems. Innovation is networked. No single company – however large – can own the full stack of capabilities required to compete in a convergent world. The most successful organizations are those that cultivate open ecosystems: partnerships with startups, academic institutions, and even competitors. Their advantage lies not in exclusivity, but in connectivity, in the speed with which they can combine technologies and scale new ideas across domains.

From speed to coherence. For years, innovation was measured by velocity: how fast a company could move from prototype to product. But when technologies converge, the challenge shifts from speed to synchronization. Progress in AI is meaningless if it outpaces progress in energy efficiency or cybersecurity. The race is not just to move fast, but also to move in harmony. Leadership, therefore, becomes an exercise in alignment, ensuring that strategy, talent, and technology evolve in concert.

> **The most successful organizations are those that cultivate open ecosystems: partnerships with startups, academic institutions, and even competitors"**

From invention to intention. Convergence multiplies potential – and consequences. As systems grow more intelligent and autonomous, the boundaries between technical choice and ethical responsibility blur. The question is no longer whether we can build it, but should we, and under what conditions. Responsible innovation is not a constraint; it is the foundation of long-term trust.

> **The race is not just to move fast, but also to move in harmony"**

Ultimately, leaders who will shape this century are those who understand that innovation is no longer a solitary act of creation, but a continuous act of connection – balancing ambition with responsibility, and curiosity with coherence.

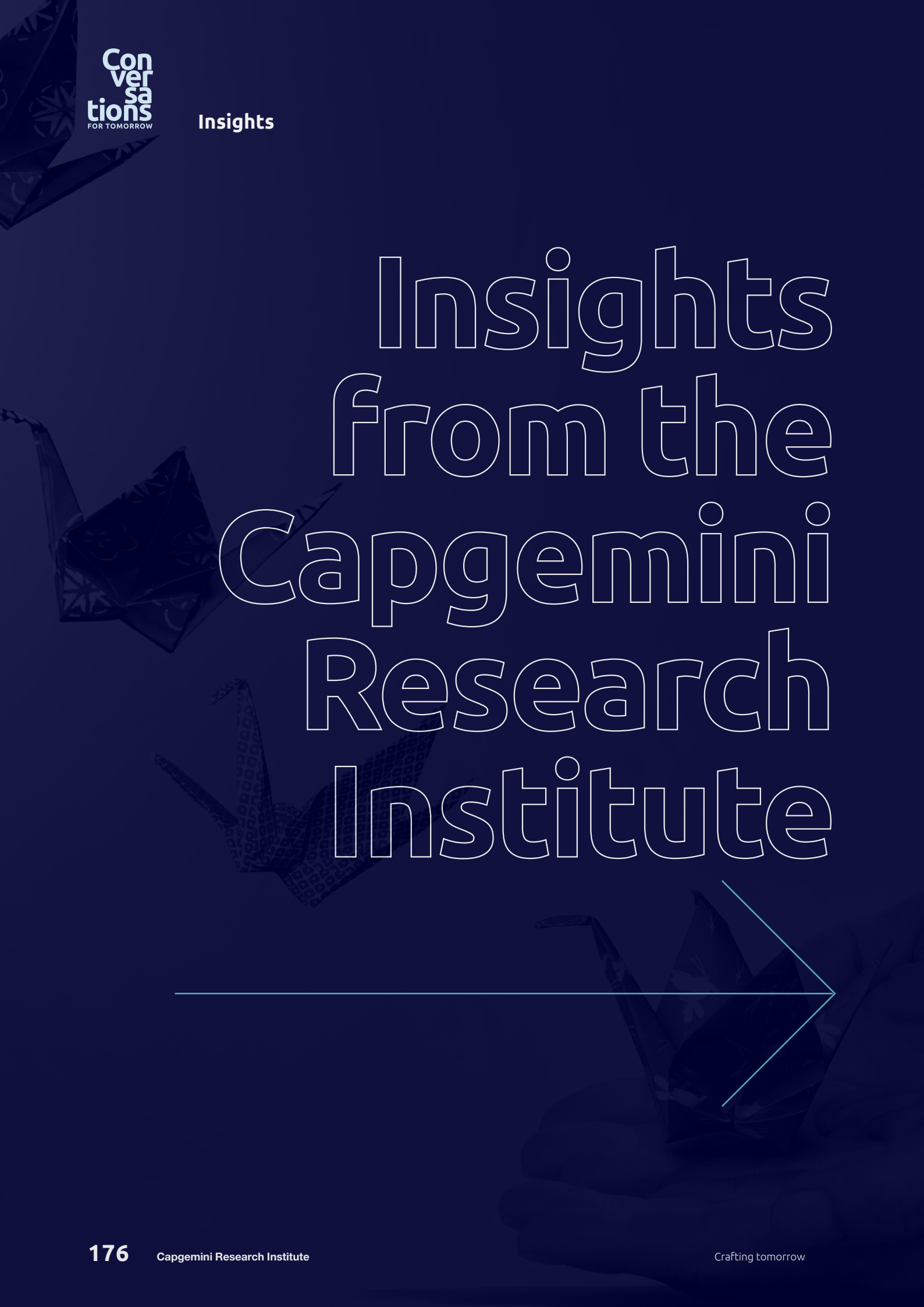
> **As systems grow more intelligent and autonomous, the boundaries between technical choice and ethical responsibility blur"**

As technologies converge, progress will come not from mastering individual tools, but from engineering the relationships that connect them: between data and matter, intelligence and energy, humans and machines. This is the new frontier of leadership: not simply to innovate faster, but to build coherence out of complexity, to shape ecosystems where intelligence, purpose, and impact evolve together.

We are entering the age of intelligent systems and autonomy, where AI reasons, quantum computes, robots act, and energy networks self-optimize. Our task now is not only to harness these systems, but to give them direction: to align intelligence with intention, power with responsibility, and progress with planetary limits. The true measure of innovation will not be the sophistication of our technologies, but our ability to make them work in concert, creating prosperity that endures, and intelligence that serves humanity.

As technologies converge, progress will come not from mastering individual tools, but from engineering the relationships that connect them"

Insights from the Capgemini Research Institute



RISE OF AGENTIC AI:

Harnessing the value of generative AI

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FUTURE ENCRYPTED:

Why post-quantum cryptography tops the new cybersecurity agenda

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Conversations FOR TOMORROW

Insights

RISE OF AGENTIC AI

HARNESSING THE VALUE OF GENERATIVE AI

For details on the research methodology and to read the full report, please visit:

https://www.capgemini.com/insights/research-library/ai-agents/

$450B

Total economic value that AI agents are expected to generate in surveyed countries by 2028

This value includes both revenue uplift and cost savings driven by AI agents

Elevates operational efficiency

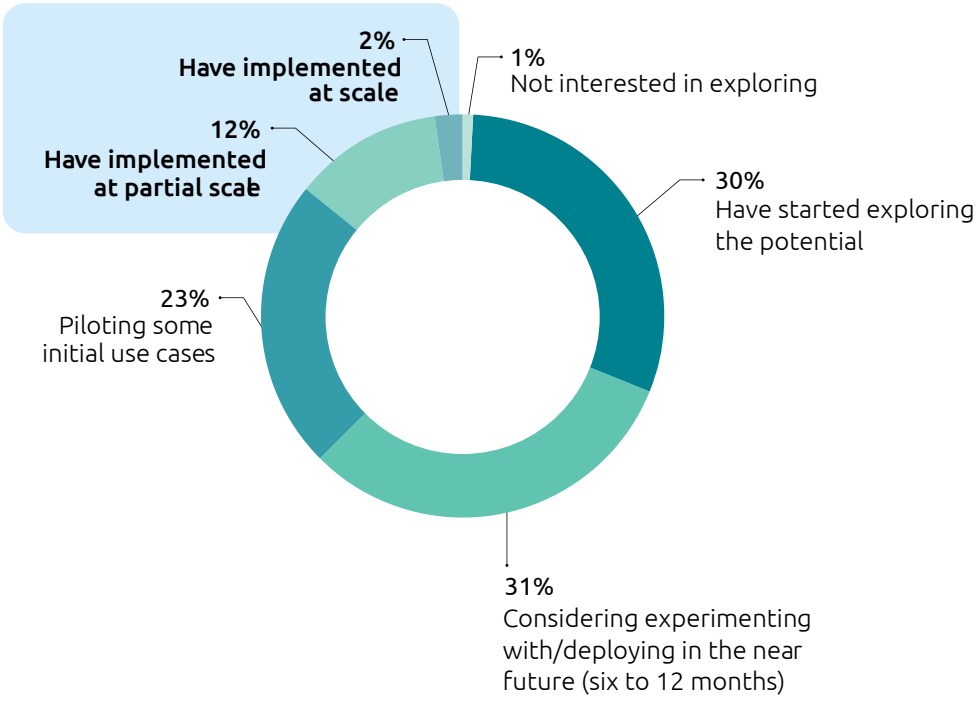
- Reduced cycle time
- Increased productivity

Boosts business growth

- New products and services
- Accelerated innovation

Adoption is already underway as organizations recognize the potential of AI agents

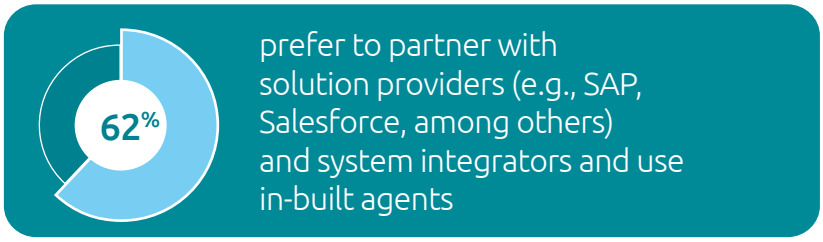
Current state of adoption of AI agents



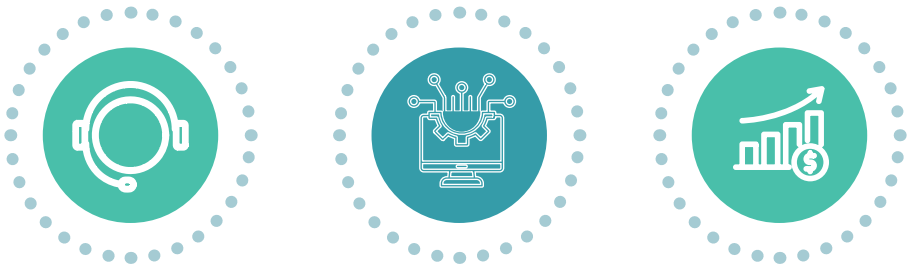
Source: Capgemini Research Institute, Agentic AI, April 2025, N = 1,522 executives from corporate and data/AI functions. Question asked: Which of the following statement best describes the current state of adoption of AI agents in your organization? Select one.

Most of the organizations prefer to use already available agents within enterprise solutions

Current state of adoption of AI agents



Business functions that could see greater adoption of AI agents

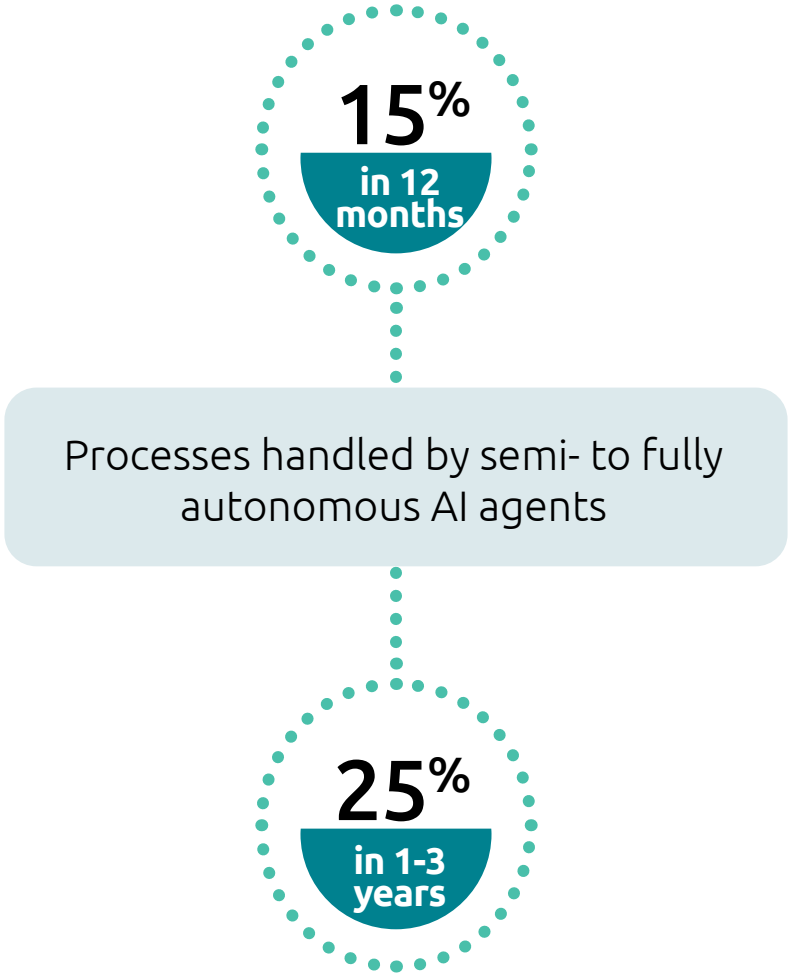


Customer services and support

IT

Sales

Organizations expect to gradually increase levels of agentic AI autonomy



However, limited trust and knowledge impede adoption of agentic AI

Trust in AI agents is declining:
The share of organizations expressing trust in fully autonomous AI agents has dropped from 43% to 27%
in the past year

Concerns around ethical implications:
Nearly 2 in 5 executives believe that the risks of implementing AI agents may outweigh the benefits.

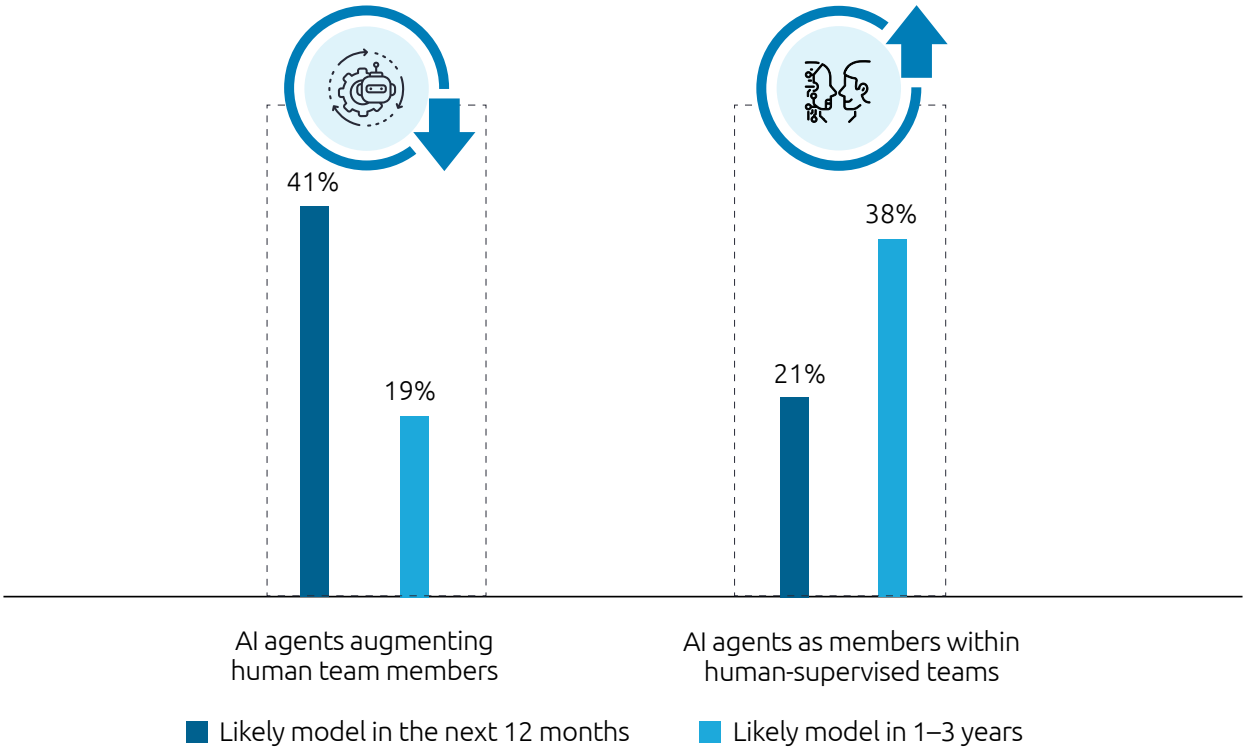
Lack of knowledge:
Only half of organizations report possessing adequate knowledge and understanding of AI agents and their capabilities

Data and tech readiness is lagging:

- Fewer than 1 in 5 report high levels of data readiness
- Over 80% lack mature AI infrastructure

Overcoming these issues will be key to building trust in AI agents as they go from augmenting humans to becoming members of human teams

Human-agent collaboration models



Source: Capgemini Research Institute, Agentic AI, April 2025, N = 1,500 executives from corporate and data/AI functions. The percentage represents the share of organizations that expect a particular human-agent collaboration model to apply to the most AI agents in their team/function.

Human involvement in processes handled by AI agents can deliver greater benefits

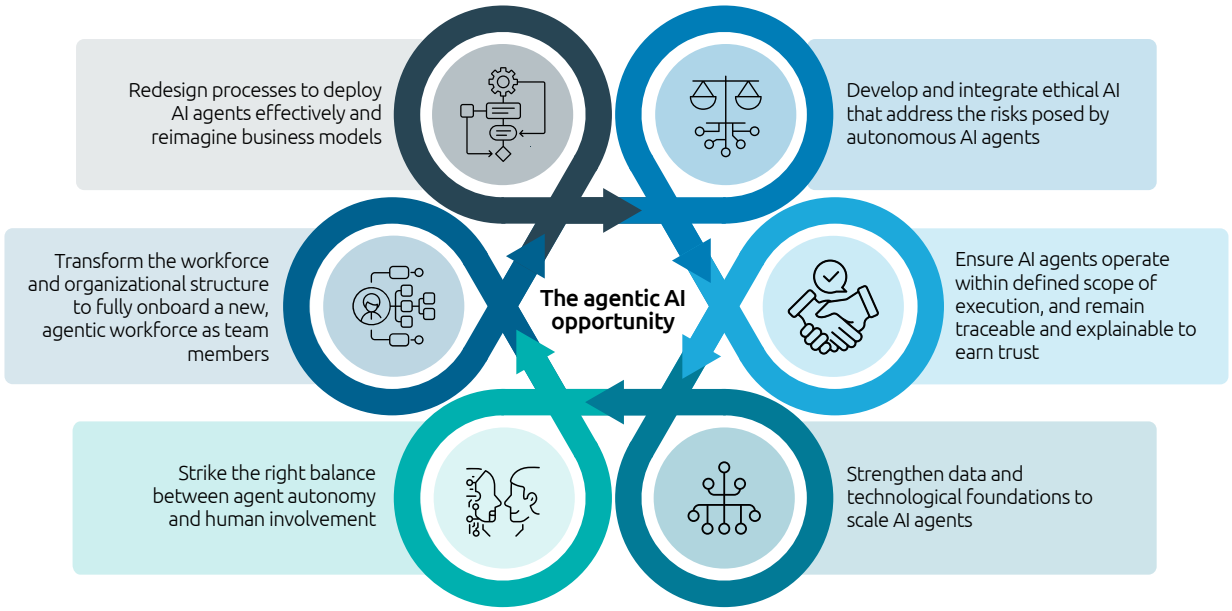
65%

greater engagement in high value tasks

53%

increase in creativity among employees

Business functions that could see greater adoption of AI agents



Conversations FOR TOMORROW

Insights

FUTURE ENCRYPTED

WHY POST-QUANTUM CRYPTOGRAPHY TOPS THE NEW CYBERSECURITY AGENDA

For details on the research methodology and to read the full report, please visit:

https://www.capgemini.com/insights/research-library/post-quantum-crypto/

Why is quantum safety a priority

Harvest-now, decrypt-later attacks

- These attacks rely on the acquisition of currently encrypted data with the possibility of decrypting it after 'Q-Day'*
- 65% of organizations are concerned about "harvest-now, decrypt-later" attacks

Global regulatory mandates

- NIST (US): Standardized PQC algorithms (Kyber, Dilithium, SPHINCS+); urges immediate integration
- NSA: RSA <2048-bit & ECC to be deprecated by 2030; disallowed completely by 2035
- EU: Recommends starting the PQC transition by end of 2026; critical infrastructures to transition as soon as possible and no later than by the end of 2030.

The ecosystem is already adapting

- AWS: Kyber-based key exchange
- Cloudflare: Hybrid PQC-TLS handshakes
- Apple: PQ3 for iMessage
- Microsoft: PQC in Windows Insider builds
- OpenSSL 3.5: PQC algorithm support

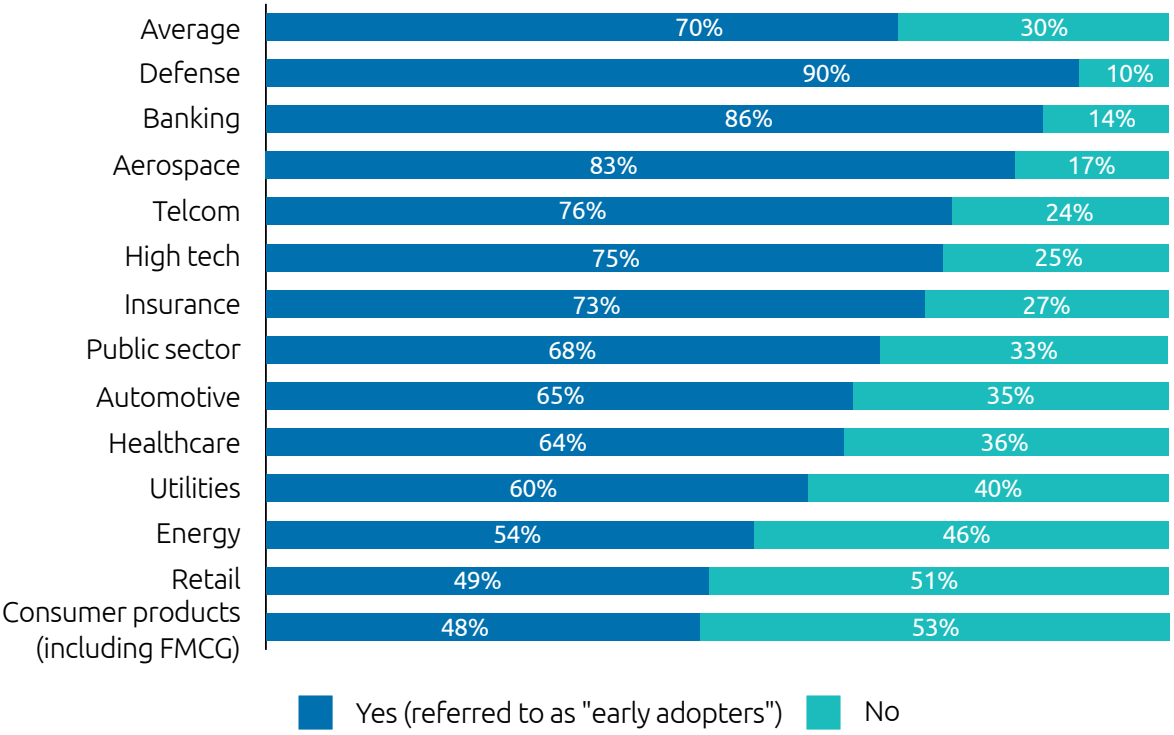
Time is running out

- CISOs underestimate the scale of transformation. Migration involves recompiling apps, replacing crypto libraries, rotating keys and updating HSMs, reissuing certificates
- Everyone soon will be scrambling for the same scarce quantum-safe talent

Source: Capgemini Research Institute, PQC survey, April–May 2025, N = 1,000 organizations; online sources.
*Q-Day is the hypothetical future date when quantum computers will become powerful enough to break the cryptographic algorithms that currently secure most of the world's digital data and communications.

Quantum safety is on the radar of most organizations

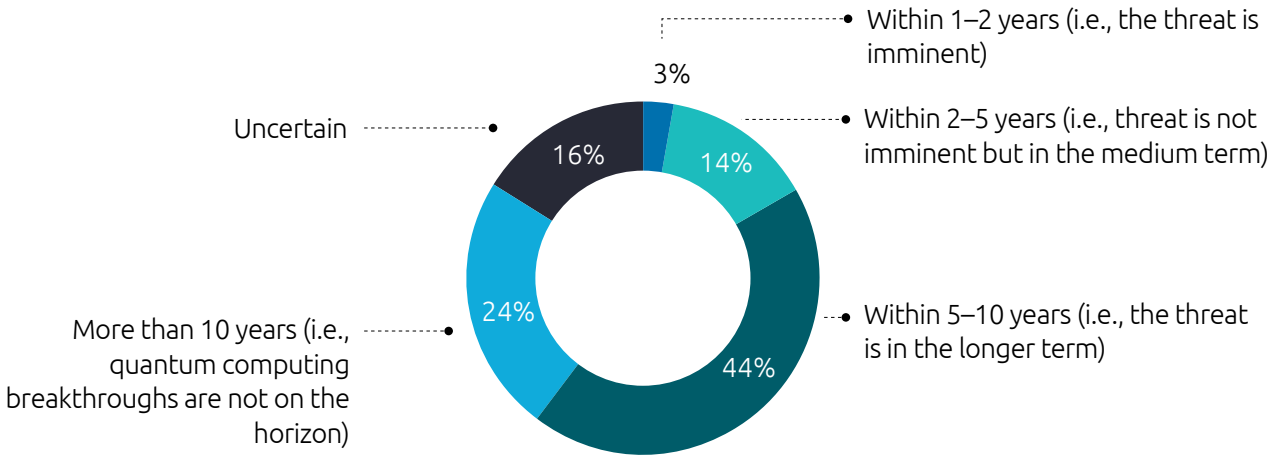
Are you currently working on or planning to use quantum-safe solutions in the next five years?



Source: Capgemini Research Institute, PQC survey, April–May 2025, N = 1,000 organizations.

Around six in ten early adopters believe that the Q-day could occur within the next decade

In your organization's view, how soon will quantum computers achieve the capability to break current encryption methods?



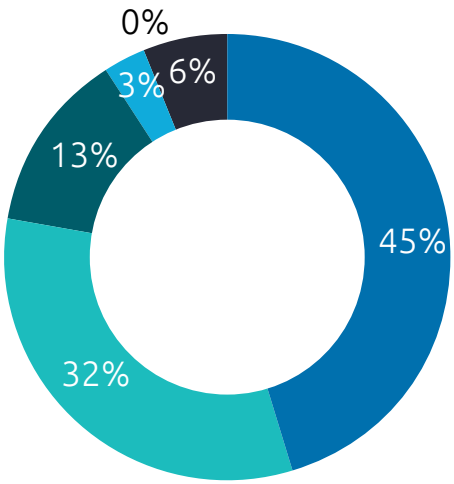
Source: Capgemini Research Institute, PQC survey, April–May 2025, N = 703 early adopters. Q-Day is the hypothetical future date when quantum computers will become powerful enough to break the cryptographic algorithms that currently secure most of the world's digital data and communications.

of early adopters view the transition to PQC as essential to maintaining their competitive edge and long-term data security

Organizations are exploring a potential transition to PQC

Nearly half of early adopters are exploring PQC concepts

Which stage is your organization at in terms of PQC adoption?

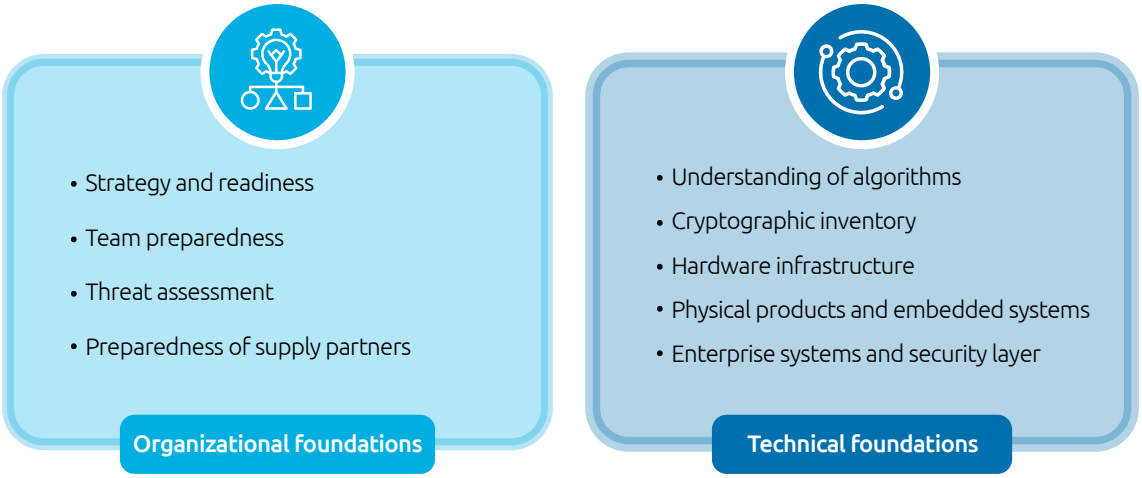


- We are exploring PQC concepts, running pilot studies, discussing with our partners, or conducting feasibility research.
- We have identified the preferred PQC algorithms (e.g., from NIST) and are aligning our internal standards accordingly.
- We are actively integrating PQC algorithms into selected systems and conducting performance, security, and compatibility tests.
- We are augmenting legacy encryption methods with PQC across multiple parts of our infrastructure.
- PQC is fully deployed and operational across all relevant operations.
- Not started/no plans currently.

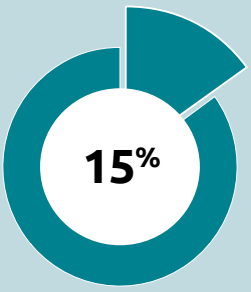
Source: Capgemini Research Institute, PQC survey, April–May 2025, N = 703 early adopters.

Few organizations are ready for the transition to PQC

Elements needed for transition to PQC

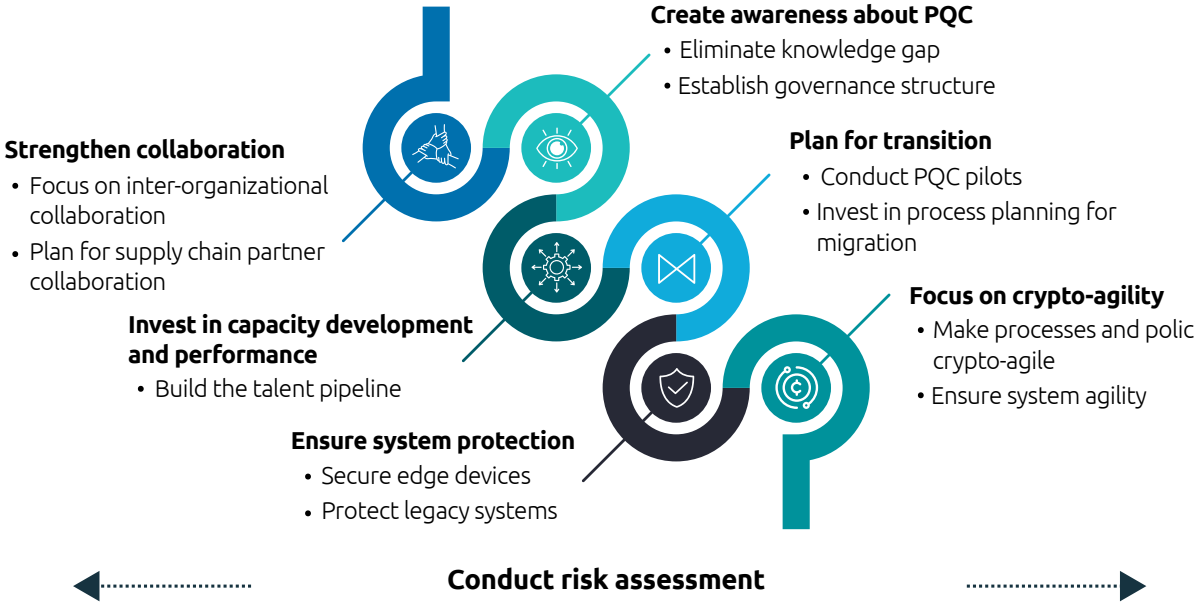


Source: Capgemini Research Institute analysis.



of early adopters are quantum-safe champions that lead in both organizational and technical foundations

How organizations can make themselves quantum-safe



Source: Capgemini Research Institute analysis.

Notes

Notes

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We are grateful to all our guest contributors for sharing their experience and insights as well as to their teams and in particular Christel Heydemann, Juliette Pignerol (Orange), Kevin Scott, Ben Skoch, Dennis Hansen (Microsoft), Annika Ölme, Aparna Srivastava (SKF), Mike Crisafulli, Amy Maggio, Sarah Brubaker (Comcast), Daniela Rus, Ozge Tekin (MIT), Yves Caseau (Michelin), David Knott, Esther Bunt, Mo Saqib (UK Government), Corence Klop (Rabobank), Walter Sun, Regina Ismail (SAP), Jeremy Utley (Stanford), and Michele Mosca (evolutionQ) for their contributions to this edition of the journal.

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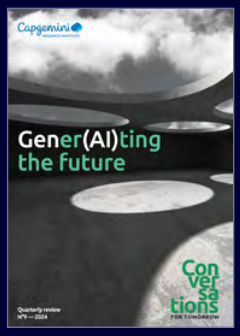

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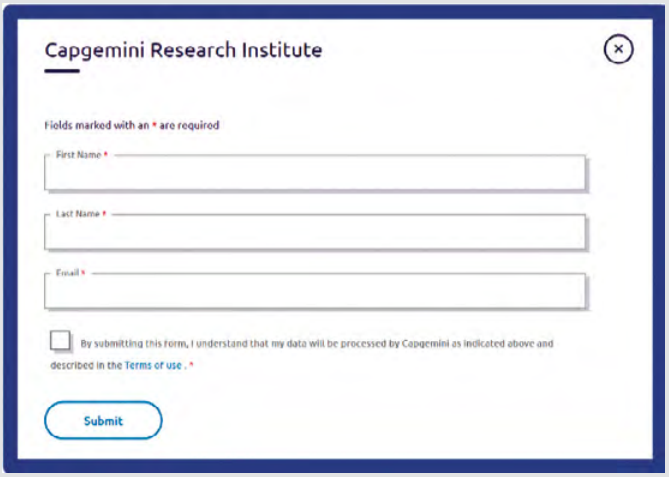

Conversations FOR TOMORROW

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