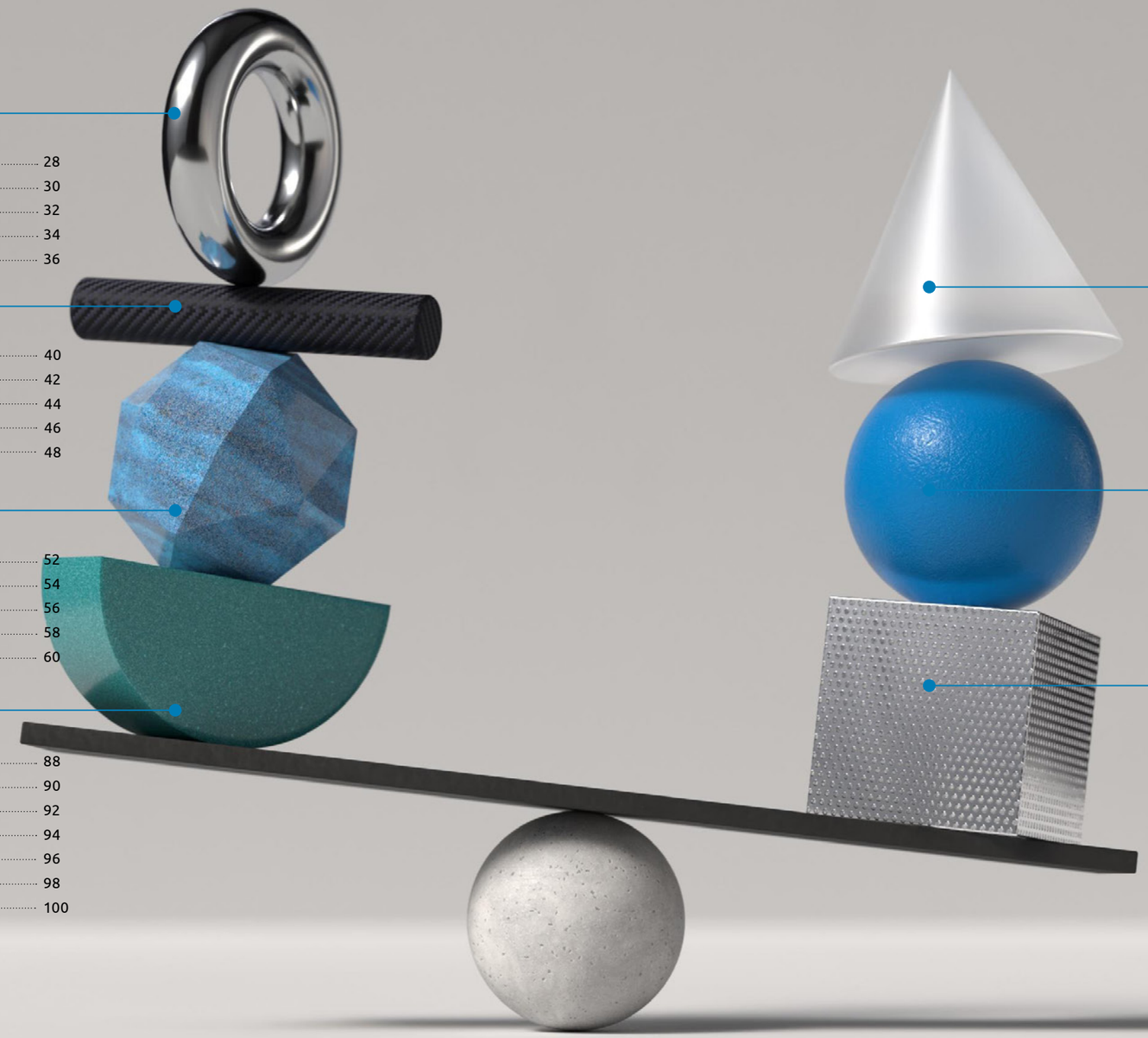
Capgemini

Techno Vision 2025

Table of Contents



Foreword

Pascal Brier

Group Chief Innovation Officer, Member of the Group Executive Committee, Capgemini

Every year, the pace of innovation seems to accelerate. The number of emerging technologies hitting the market continues to grow, and their impact is felt globally across industries. The rise of generative AI in the past two years is a perfect example of how technology can take the world by storm.

Last year, we anticipated the emergence of smaller generative AI language models and AI agents. We signaled the importance of postquantum cryptography, and evolutions in many other domains.

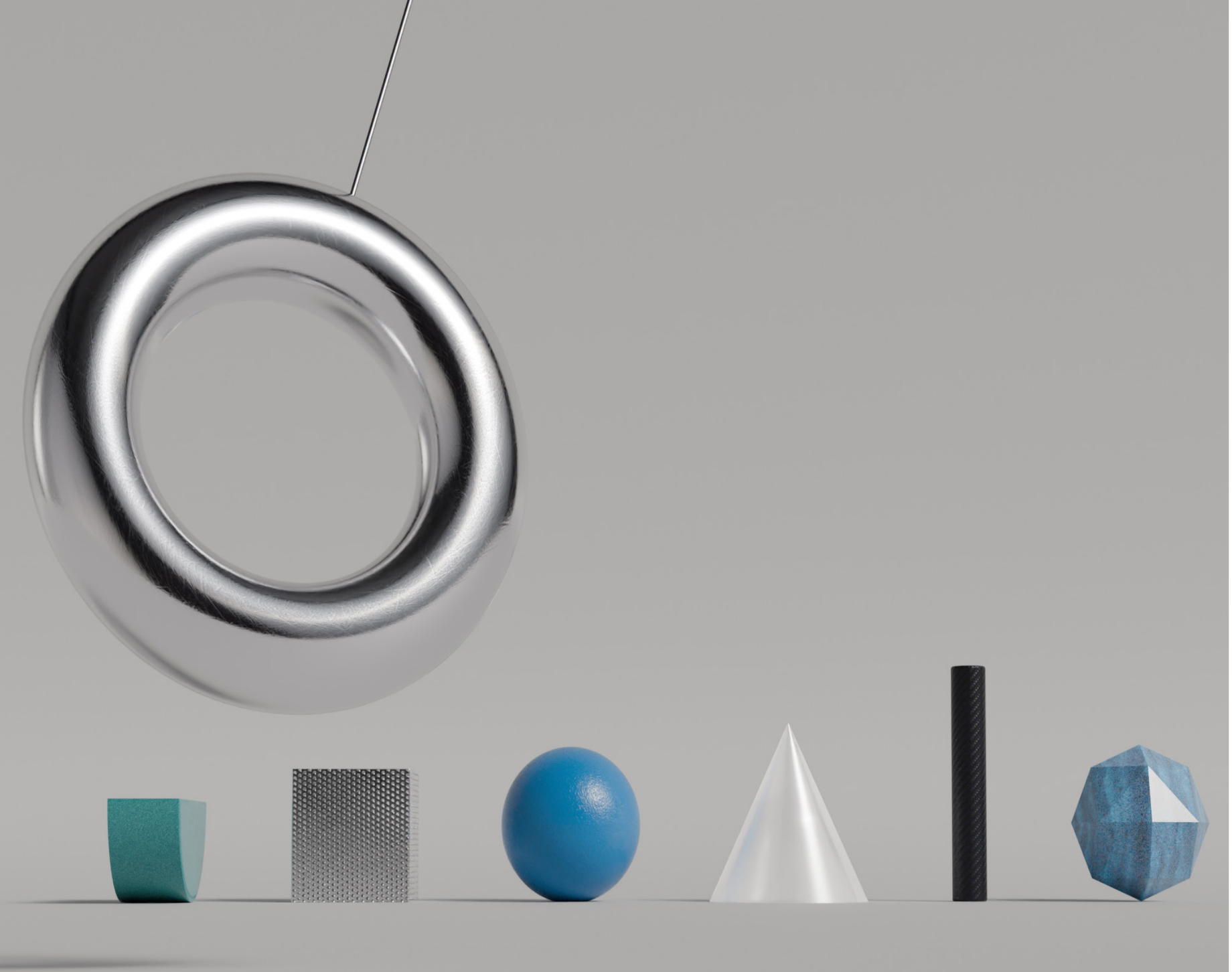
We saw these predictions come to life and have been able to help our clients not only understand the technologies but establish sound strategies around them and invest, when and where it made sense for their business.

Through our TechnoVision program, our global network of research and innovation teams are once again at the forefront of innovation, taking the pulse, scouting ideas and ultimately identifying which technology trends will be driving change — this year, and in the years to come.

For both business and technology leaders, it is a matter of identifying what technology trends are key, filtering out the essence from the hype, and balancing innovation, and the early-adaptor advantage with enterprise scale and tangible benefits.

This is where *TechnoVision* for CIOs and CTOs comes in. It provides not just a vision, but also an elaborate framework and a toolbox packed with playful innovation elements. It contains all you need for ideation, brainstorming, solutioning and any other innovation engagement. This foundational asset sets you up for a year of continuous technology-powered imagination and change.

You don't have to read this edition from beginning to end. Instead, you can dive into it again and again, even daily. We guarantee you'll always find something new, something exciting, something that may spark your next great idea.



The Pendulum Swing

It was a crisp winter morning in 1851 when curious Parisians gathered under the majestic dome of the Panthéon to witness a scientific spectacle that promised to unravel one of nature's greatest mysteries — or at least give them something to talk about. Suspended from a height of 67 meters, Léon Foucault's pendulum — a hefty brass sphere tethered to a long wire was set in motion, swinging back and forth in a seemingly simple arc. As time passed however, the pendulum's path slowly shifted, proof that the Earth itself was rotating beneath. Foucault's experiment, though ostensibly about the physical world, did more than merely confirm a fact. Combining time and momentum, it elegantly uncovered the balance of forces that underpin motion.

Fast forward to today's digital era, and the image of Foucault's pendulum is an apt metaphor for the ceaseless oscillation between opposing forces in technology business trends that will define 2025 and beyond.

A World in Motion

It is not a search for equilibrium, rather an act of perpetual balancing as we keep swinging from left to right — just ever so briefly passing the center — only to find we are moving in circles. Sustainability agendas may be overshadowed by political, economic, and geopolitical dynamics as they were in the past by COVID 19 as well. Unpredictable events in war and peace revitalize a drive towards sovereignty and putting local priorities first, above global collaboration and communities. Financial markets may fluctuate accordingly, and budgets may be spent differently. Yet again, the scarcity of human and natural resources may be a determining economic factor. Global trade may be under more pressure than seen in a long time, and consumer behavior may follow in the same, whimsical patterns. As a result, supply chains seem to be destined to be disrupted and broken, over and over again.

Whenever we are tempted to believe in the illusion of a perfect balance — after carefully manipulating and positioning the components of challenges and solutions — we will find the wrecking ball of the pendulum swing approaching, ready to stir it all up. One thing is for sure though, whatever scenarios pan out, technology is a fully integrated part of it, as every transformation nowadays is a digital transformation.

Top Tech Trends

What are then the technology trends that will define 2025? To help answer that, the Capgemini Research Institute produced its *Top Tech Trends report 2025*. Based on a survey of 1,500 senior executives and 500 VCs in 15 countries in Europe, the Americas and Asia Pacific, it found 5 trends that are likely to reach an inflection point in 2025:

- **Generative AI: From copilots to reasoning AI agents**

Autonomous intelligent systems are becoming more prevalent in performing certain tasks. These AI agents are capable of learning and adapting to new situations, making them valuable assets in various industries, from customer service to healthcare. A significant 32% of surveyed executives rank AI agents as the top technology trend in data and AI for 2025. The next step in this tech evolution will be the rise of the 'super agent,' capable of orchestrating and optimizing multiple AI systems. In 2025, these advancements will enable new AI ecosystems across industries, elevating efficiency and innovation to new heights.

- **AI & Gen AI in cybersecurity: New defenses, new threats**

AI is transforming cybersecurity from both sides of the legal divide, elevating both cyberattacks and cyberdefenses to new levels of sophistication. At the moment, the criminals have their noses ahead: almost all organizations surveyed (97%) in our recently published report say they have suffered breaches or security issues related to the use of gen AI in the past year. Around 44% of top executives in the survey consider the impact of gen AI on cybersecurity as the top technology trend in cybersecurity for 2025.

- **AI-driven robotics: Blurring the line between human and machine**

Collaborative robots (cobots) and AI-driven robotics are used in various industries to enhance productivity and safety. These technologies enable human and robot to perform precision tasks in concert. Around one-quarter (24%) of top executives and 43% of VCs see AI-driven automation and robotics as one of the top three tech trends in data and AI in 2025. While hard-coded, task-specific machines used to dominate robotics, the development of gen AI is spurring the development of new products (including humanoid and collaborative robots) that can adapt to diverse scenarios and learn continuously from their environments. With robots creeping towards full autonomy and AI taking on complex decision-making roles, the future of work may see a shift in traditional hierarchies.

- **The surge in AI is driving nuclear resurgence**

Nuclear energy is a focal point for 2025, propelled by the urgent need for clean, dependable, and controllable power (in part owing to the rise of AI and other new tech). Although, in September-October, 2024 very few top executives globally identified small modular reactors (SMRs) as a top-three sustainability technology for 2025, the surge in SMR-related news in the last few weeks of this year suggests 2025 could be pivotal.

- **New-generation supply chains: Agile, greener, and AI-assisted**

In recent years, businesses have had to navigate increasingly complex, unpredictable market conditions. Technologies including AI, data, blockchain, Internet of Things (IoT), and connectivity with terrestrial-satellite networks, play a strategic role in enhancing cost efficiency, resilience, agility, circularity, and sustainability of supply chains. Unsurprisingly then, 37% of top executives see these new-generation supply chains as the top tech trend in industry and engineering in 2025. Additional regulatory and environmental constraints will make this shift critical to ensuring competitiveness, agility, and resilience.

Swing Movements in Technology

It's obvious from our research that AI still plays a major role in the near-future expectations of both business executives and venture capitalists. But right underneath that seemingly egal surface, we can see the pendulum swing of emerging technology in full action.

Just consider the swing between human and artificial intelligence: as AI algorithms become more capable, predicting, and generating content that once required uniquely human capabilities, we find ourselves in a delicate trade-off between the augmentation of human potential and the fear of surrendering our autonomy to opaque technology. Similarly, whereas generative AI has whetted the appetite in the boardroom for technology like never before, the hard realities of scale, reliability, sustainability, and cost kick in as organizations move to deploy AI at scale.

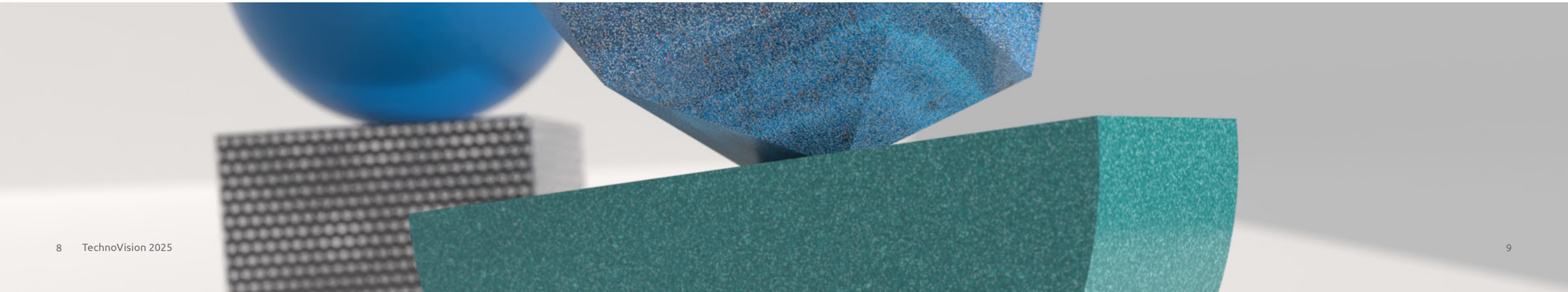
The pendulum also clearly swings between technological abundance and sustainability. As computing power increases exponentially, so does the energy it consumes, raising concerns about the environmental impact of data centers and IoT devices. It even almost singlehandedly revitalized the interest in innovative nuclear energy. We're at that perpetual point of tension — striving to harness the full potential of technology while trying to curb its ecological footprint.

Then there's the balancing between speed and security: as the pace of technological advancement accelerates, ensuring that data and systems remain protected from threats becomes ever more challenging. And, of course, who could overlook the tug-of-war between working from the comfort of our homes and returning to bustling office spaces? It's another delicate balance act, as organizations attempt to find the equilibrium — if that even exists — between flexibility and face-to-face collaboration.

Furthermore, there's the ongoing debate between global versus local approaches to technology and the tension between open versus sovereign systems. As we aim for more open, interoperable technologies, there's also the growing demand for digital sovereignty, with countries and regions wanting to protect their data and infrastructure from an external grip.

The always ongoing quest for personalized user experiences faces off with the need to protect individual privacy (unless there's profit in it); the demand for ever-increasing data storage versus the limitations of physical infrastructure; and the push for digital inclusivity while acknowledging that, well, not everyone can afford the latest gadget. In every corner of our tech-driven society, the pendulum swings, tracing an arc that defines our ongoing pursuit of balance — or at least the appearance of it.

In this way, Foucault's pendulum serves as an elegant reminder that while technology trends may oscillate wildly from one extreme to the other, the real challenge lies in maintaining balance. Just as the pendulum's motion was both predictable and awe-inspiring, so too is the rhythm of our digital age — a continuous, swinging negotiation between progress and preservation, swollen expectations and sobering realities, stability and volatility, freedom and control, the global and the local, the open and the sovereign, the physical and the digital, the artificial and what's real.



New Trends

The newly introduced trends in TechnoVision 2025 bring fresh illustrations of how innovative technologies continue to reshape businesses, society, and even us as individuals. Whether it is in user experience, collaboration, process automation, data, applications, infrastructure or in design principles, all of them are also indicative of the swing movements of different forces and dynamics.

In user experience:

- **Face to Interface.** From factory floors to personal advisors, user interfaces are taking on a human face, making technology feel less like a tool and more like a partner. These AI agents don't just simplify complexity, they collaborate, converse, and connect, turning intricate experiences into intuitive ones and putting humanity at the heart of innovation.
- **You're Something Spatial.** Where digital meets physical, spatial technologies are transforming user experiences. Combining digital twins, real-time 3D, and AI-powered vision, they merge what we see with what we need to know. From entertainment, virtual shopping, learning, factory floors to smart cities, they enable immersive insights, smarter decisions, and hyper-personalization — all while putting users at the center of innovation.

In collaboration:

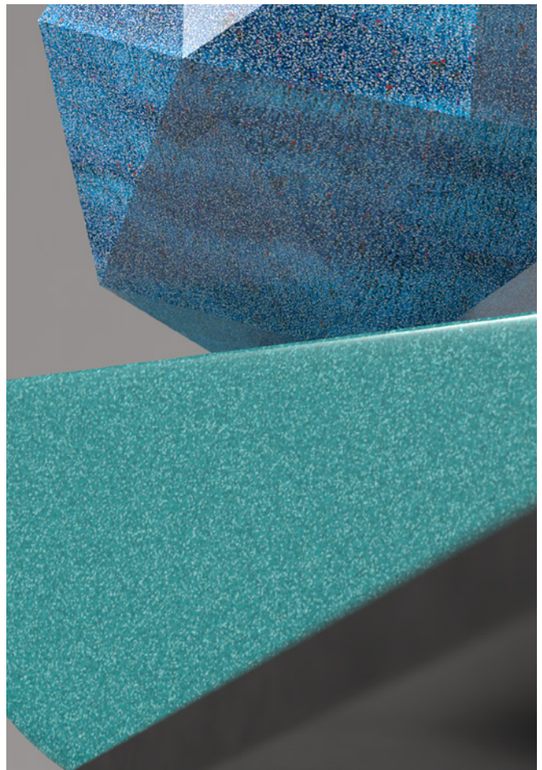
- **Autonomous Agent Alliance.** As businesses embrace autonomy, machine customers and intelligent agents are stepping up as key collaborators. Yet, the secret sauce remains the human touch — essential for building trust, safeguarding privacy, and ensuring resilience. It's less about replacing humans and more about crafting a seamless alliance between minds and machines.
- **Synergy².** The future of work thrives on synergy: human creativity paired with AI-assisted tools and automation. This partnership optimizes tasks while empowering workers to focus on innovation. Balancing virtual and physical workplaces becomes key, blending the flexibility of remote collaboration with the richness of in-person connection to create truly adaptive workflows.

In process automation:

- **Whole Lotta Fusion.** When the physical world fuses with digital intelligence, it's a highway to overdrive. Digital twins, which are high-fidelity replicas of physical processes, allow organizations to simulate, monitor, and optimize without breaking a sweat. This fusion bridges virtual and real-world scenarios, enabling risk-free experimentation and electrifying operational visibility. The result? A whole lotta impact, delivered through sleek, digitally enhanced processes that truly rock.
- **Ctrl-Alt-Human.** Automation is stepping up, but it may be time to hit the reboot key and bring the human element back into focus. Ensuring people remain central to processes means blending intuition and oversight with machine efficiency. From critical decisions to ethical guidance, humans bring the adaptability and judgment needed to align automated outcomes and actions with corporate and societal priorities. Amid all the technological breakthroughs, the real reset might just be rediscovering the power of the human touch.

In data:

- **Data Sharing Is Caring (But Take Care!).** Sharing data is a game-changer for innovation and collaboration — even among competitors. From internal platforms to real-time exchanges, data ecosystems are thriving. But don't overshare! In the age of generative AI, integrity, privacy, and compliance are non-negotiable. Treat data like a VIP product and share responsibly because caring also means taking care.
- **AI Meshed Up.** AI solutions are no one-size-fits-all affair. They're a dynamic mesh of multimodal, multi-model, and hybrid systems. These interconnected AI agents create adaptive feedback loops, driving efficiency and autonomy. But flexibility comes with challenges: transparency, ethical oversight, and calibration are critical. In this evolving AI mesh, progress is balanced by trust-building and continual fine-tuning.



In applications:

- **App = A Robot.** What if your next application isn't just software, it's a robot? As robotics joins the application canvas, software engineers face thrilling new possibilities and equally intriguing challenges. From intelligent automation to physical interaction, apps are no longer confined to screens. But with great innovation comes complexity: coding for movement, decision-making, and real-world unpredictability. It's time to think beyond clicks and swipes because in this brave new world, your app might just walk, talk, or roll into action.

In infrastructure:

- **Everything, Everywhere, All At Once Connected.** Connectivity has become the star of the digital age, transforming from a supporting act to the fabric uniting industries and technologies. With 5G, satellite networks, edge computing, and soon 6G, it's the infrastructure that indeed enables everything, everywhere, all at once — not just a play on a movie title, but a hyper-connected reality. And equally award-winning.
- **Cloud Encounters Of The Third Kind**. As the cloud frontier expands, businesses are having their own close encounters with a whole new kind of IT. It's driven by industry clouds, specialized AI setups, and a galaxy of embedded tools. The new cloud isn't just about storage and compute; it's about sovereignty, sustainability, and an increasingly diverse mix of deployment options. With a focus on net-zero operations and dynamically optimized workloads, it not only enables a new operational reality but also reduces carbon footprints.

Finally, in design principles:

- **augment ME!** Building on TechnoVision's main theme of last year, this principle motivates us to consider the augmentation power of technology (notably AI) for every aspect of business and its technology solutions, including the IT and solutioning processes themselves. It addresses the need to change our traditional views on the notion of knowledge, understanding, and ultimately, our judgment.
- **Real <-> Smart.** What if the swing comes full circle? When we seek to augment ourselves with technology, exploring the edges of both smart technology and being real humans, we may find a new, regenerated perspective on humankind itself — and the planet. Then we'll repeat. For that, organizations need to think more long game, borrowing from nature's playbook itself — adapting, renewing, and thriving in harmony rather than bulldozing ahead.

The Plan

Just like us, Italian writer Umberto Eco was inspired by Foucault's experiments. In his famous book *Foucault's Pendulum*, Eco introduces a trio of thinkers — although clearly not digital strategists: Casaubon, Belbo, and Diotallevi. They engage in playful creativity, weaving disconnected historical dots into an elaborate fiction. Their plan then becomes more than a game, drawing them into a whirlwind of intrigue, turning the book into the grand novel it is. But at its core, Eco's story celebrates the human quest for meaning, curiosity, and connection, even amidst chaos and uncomprehensible complexity.

In today's technology landscape, the pendulum swings in a similar rhythm. Like Eco's characters, we create systems that connect disparate elements — AI, IoT, edge computing, robotics — into powerful networks that seem to hum with their own logic. Far from being a cautionary tale, this interconnectedness offers boundless opportunities: richer collaboration, dynamic adaptability, and innovations that reshape industries.

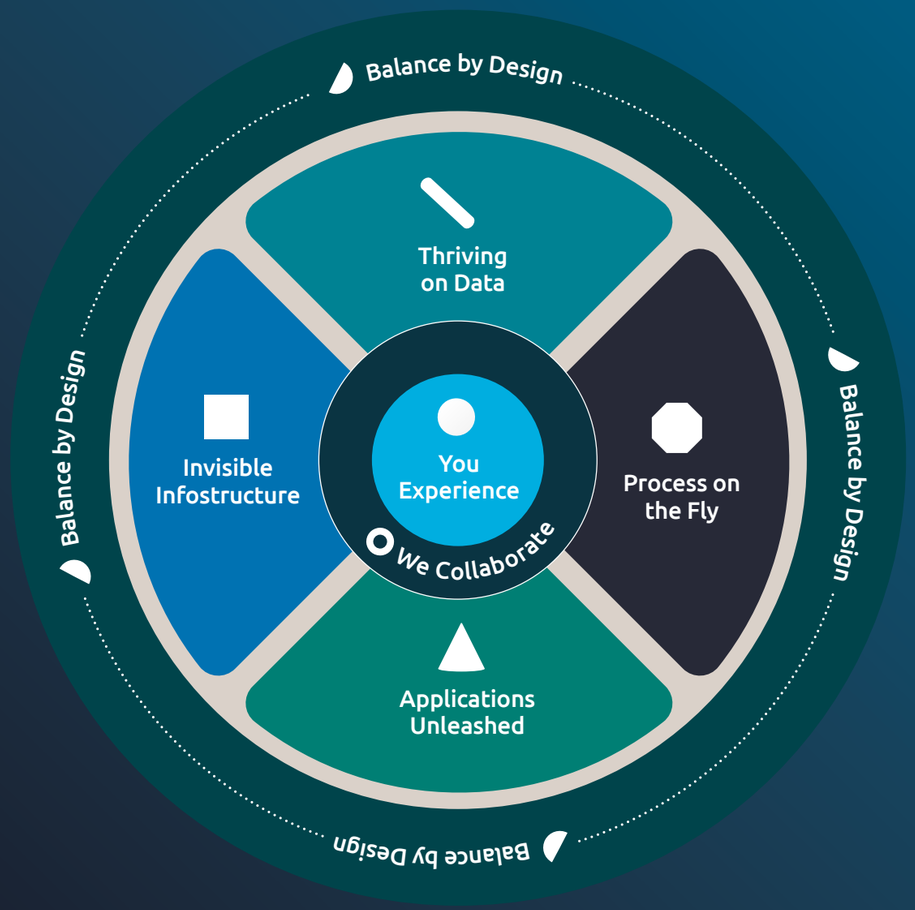
Yet Eco's story reminds us that meaning emerges not from blindly following the systems we create but from engaging with them thoughtfully. As we keep trying to balance autonomy with oversight, global ambition with local needs, sustainability with scalability, innovation and scale, we're not just building technologies; we're crafting narratives of progress that define who we are. The lesson isn't fear of losing control but embracing the creative tension that drives truly new ways. Like the pendulum, it's a constant swing — measured, purposeful, and always on the move.

In any case, the law of physics dictate that the pendulum only keeps swinging if we add energy to it. Hopefully this new edition of TechnoVision will provide plenty of it.

Overview of TechnoVision

TechnoVision categorizes technology trends into seven 'containers', the first six providing a snapshot of innovation from different perspectives: the 'what' — ranging from user experience and collaboration, via data and process automation, all the way to infrastructure and applications. A seventh container captures a series of overarching design principles to successfully apply the trends and create transformational impact: the 'how'. These principles help to build a sharp mindset, ready to apply to any portfolio, program, project, architecture, innovation initiative, or idea.

You Experience or trends in user experience and **We Collaborate** or trends in collaboration are at the very heart of technology-powered change. This core foundation is surrounded by four enabling containers: **Thriving on Data** or trends in data and AI **Process on the Fly** or trends in process automation and management, **Applications Unleashed** or trends in applications, and **Invisible Infostructure** or trends in infrastructure. The collection of trends is all wrapped up with **Balance by Design** or trends in design principles, as the overarching container to always be considered while working with the others.



Containers

While trends change over the course of the years — some of them are newly introduced in a year, others disappear, yet others stay — we find the containers make up a stable, dependable foundation to discuss and assess a digital landscape. The names of the containers are aspirational. They suggest a desirable yet always evolving state to be strived for; in a way, they are self-explaining. The user experience becomes a true **You Experience**, when it is optimally tuned to the expectations, objectives and context of its users. When collaboration is jointly owned and embraced by all stakeholders of a teaming effort, it's where we want to be with the trends in **We Collaborate**. These days, it's not so difficult to point out the transformative power of data and AI, but only when true data mastery is achieved at all parts of the organization, it's **Thriving on Data**. When a process is a **Process on the Fly**, it is not only easy to configure and modify, it also perfectly enables the needs and flows of the organization. Liberating applications in **Applications Unleashed** has two sides: freeing the organizations of the burden of inflexible, outdated applications, but also benefiting from a new generation of agile, smart application services. Within **Invisible Infostructure**, there is always the quest of turning (IT) infrastructure into a more seamless, trouble-free utility, while capturing and providing more data and connectivity from more diverse place. Finally, the principles of **Balance by Design**, stimulate a perpetual effort to balance the different success and fail factors of change, not as an afterthought but integrated into all strategic, architectural, design and solutions development efforts.

Every container kicks off with an overview page, consisting of 4 sections: the *Where We Are*, more or less an expression of the state of the nation of the container, *Balancing Act*, building on TechnoVision's main theme of this year, it explores the different dynamics within the container, *New Trends*, which introduces this year's new trends in the container, and finally *3 Steps To Take*, suggestions for actionable follow-up.

Trends

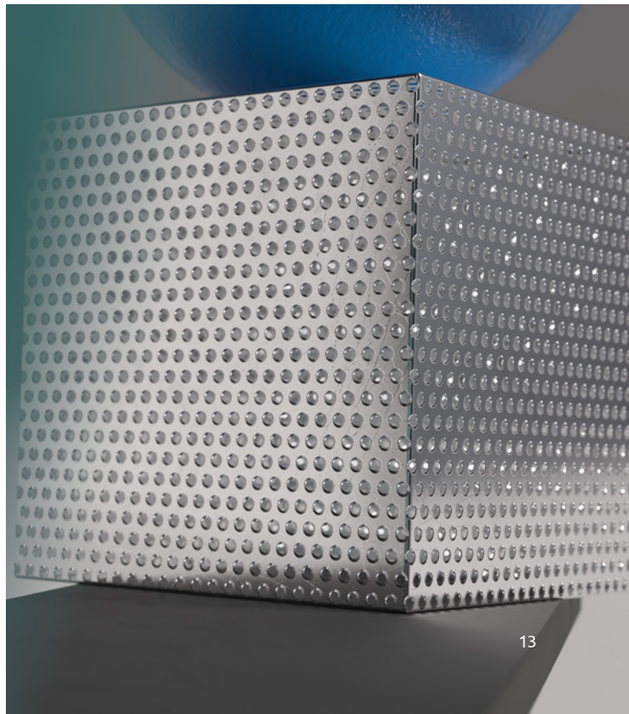
Within each container, five key trends are presented as one-page summaries, designed to be crisp and to-the-point, yet appetizing enough to warrant further study. They all feature a *what* section that describes the trend, a *use* section with best practices and use cases, an *impact* section that exemplifies the change potential of the trend, and a *tech* section that provides links to key technologies and standards. Each trend also mentions an expert in residence with whom anyone can connect if they want to know more about the topic.

Balance by Design follows a slightly different setup to the other six, presenting views of how to balance within an organization using seven clear design principles — including antiprinciples that are remarkably often easier to detect than the principles themselves.

Playful

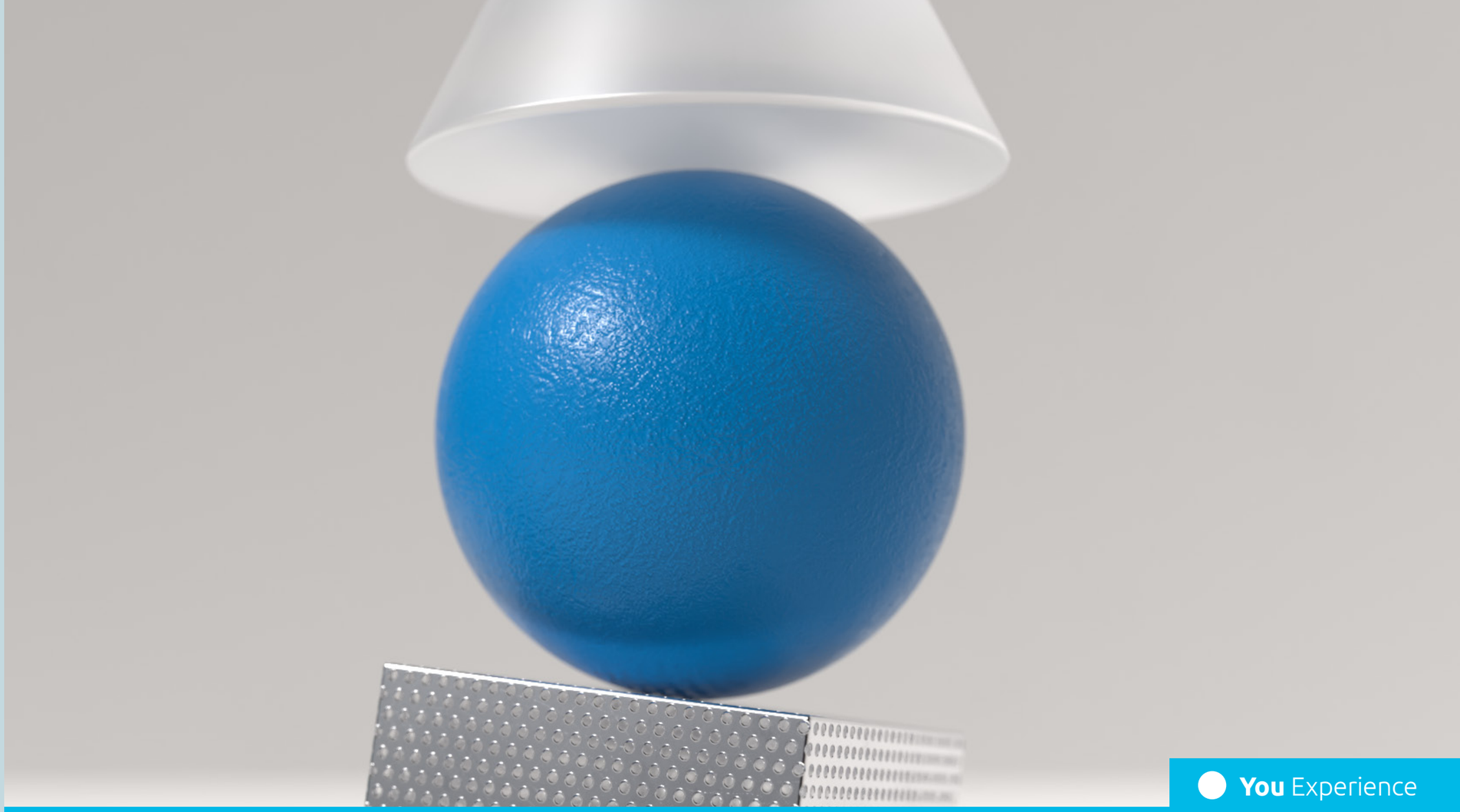
As will be obvious from some of the trends above, our authors have stayed true to the playful nature of TechnoVision by using references to rock, pop, movies, and other cultural and societal phenomena. It turns out this playfulness makes the trends more accessible, more compelling, and easier to remember. Also, as our authors will testify, it's good, clean fun creating these headings. Although we acknowledge that the understanding of references and wordplay will differ — depending on for example age and country of residence — readers are challenged to find as many of these 'Easter Eggs' as possible.

The TechnoVision expert in residence community caters to a variety of detailed posts and articles about your favourite 37 building blocks. We encourage you to read the accompanying report *Applying TechnoVision* for various means of using and playing with TechnoVision in a unique and entertaining way. Finally, to dive even deeper into the TechnoVision universe, watch out for the industry playbooks: released throughout the year as they provide numerous sector cases and best practices, positioned within the TechnoVision framework.



Alexandre Embry
Expert in Residence

You Experience



Where We Are

The era of the true **You Experience** has arrived, where digital interactions adapt seamlessly to individual needs — whether for customers, employees, or even the occasional rogue algorithm. This isn't just personalization; it's the ultimate crossover event, merging physical and digital worlds with AI, advanced visualization, natural interfaces, and digital twins of everything delivering interactions so natural they might as well shake hands.

Human-like agents are rewriting the rules of collaboration, offering predictive insights, smarter decisions, and task automation with a conversational flair. The result? Businesses that run faster, smarter, and greener — crafting experiences so attuned, it's almost like they read your mind. Almost.

Balancing Act

User experiences are becoming a tightrope act, balancing personalization with privacy, automation with the all-important human touch, and efficiency with a dash of empathy. AI and large vision models can deliver hyper-relevant interactions. But who's watching the watchers? Human-like agents and cognitive twins promise speed and precision yet leaving them unchecked might turn collaboration into a sci-fi cautionary tale. And let's not forget the dynamics between sustainability and immersion: businesses strive to reduce waste and energy use while delivering digital experiences so seamless, users might wonder if they've stepped into the matrix. Balance, as always, is the ultimate trick here.

New Trends

The newly introduced trends in the You Experience container show exciting, fresh approaches to user experiences, while also being indicative of some of its conflicting forces and dynamics:

- **Face to Interface**. From factory floors to personal advisors, user interfaces are taking on a human face, making technology feel less like a tool and more like a partner. These AI agents don't just simplify complexity — they collaborate, converse, and connect, turning intricate experiences into intuitive ones and putting humanity at the heart of innovation.
- **You're Something Spatial.** Where digital meets physical, spatial technologies transforms user experiences. Combining digital twins, real-time 3D, and AI-powered vision, they merge what we see with what we need to know. From entertainment, virtual shopping, learning, factory floors to smart cities, they enable immersive insights, smarter decisions, and hyper-personalization — all while putting users at the center of innovation.

3 Steps to Take

1. **Embrace AI and spatial technologies for hyper-personalization and humanized types of interactions.** Integrate AI-driven systems, large vision models, and spatial computing to create immersive, context-aware user experiences. Blend physical and digital worlds to deliver hyper-personalized interactions across customer and employee journeys. These technologies not only enhance training, collaboration, and decision-making but also drive efficiency and competitiveness across industries.
2. **Leverage digital twins and cognitive agents.** Adopt digital twins and human-like intelligent agents to simulate, predict, and optimize operations in real-time. Use these systems to improve human and AI collaboration, automate complex tasks, and reduce errors. By bridging virtual and real-world environments, businesses can reduce costs, speed up innovation cycles, and enhance sustainability efforts.
3. **Balance innovation with sustainability.** Align cutting-edge digital experiences with sustainable objectives. Focus on reducing physical footprints, energy consumption, and waste while fostering smarter decision-making and automation. This approach not only addresses pressing global challenges but also ensures long-term value for businesses, their customers, and the planet.

Carolina Sanchez
Expert in Residence

Face to Interface

When AI agents look, sound, and act like us, interaction feels as natural as human-to-human

From factory floors to personal assistants, AI agents are stepping out of the shadows and putting on a human face. These agents don't just work for us — they work with us, making interactions as natural as a conversation with a friend. Whether managing complex tasks in fintech or guiding customer decisions, they relate to us on our terms, building trust and transforming how we connect with technology. The result? A seamless partnership that feels less like talking to a machine and more like teaming up with an ally. Something we'd all like to face.

What

- AI agents are developed with different degrees of autonomy to perform tasks that humans are incapable of, due to the sheer amount of data involved, and the complexity and the speed of the analysis required to create a range of possible outputs.
- These agents, either in single or multi-agents' solutions, are being embedded in all sorts of applications such as manufacturing (anomaly detection), transport (intelligent systems), fintech (automating processes) and consumer (customer services, recommendation engines).
- This rapid advancement of AI agency, and its speed of scale, has prompted the need for everyone (not only technical experts) to be able to understand and interact with agents to benefit from their value. This has opened up a huge opportunity for designing AI agents that are more relatable to us and can use human-like communication channels.
- Communication is becoming two-way, allowing humans to issue commands in natural language. For example, agentic AI systems that can handle complex tasks based on a set of instructions, are being developed as personal assistants.
- For a successful integration of all these AI agents within human activities, a design with human-like characteristics can provide more relatable and familiar interfaces needed for different but specific contexts (e.g. healthcare, education, customer services).

Use

- **Siemens** has introduced a new Hydrogen Plant Configurator, a gen AI-based chatbot that enables users to create precise layouts of the system units and connections and predicts key figures such as possible power consumption, heat generation for hydrogen production etc.
- **Mercedes Benz** is adding e-commerce capabilities into its online storefront with a gen AI-powered smart sales assistant. Mercedes also plans to expand its use of Google Cloud AI in its call centers and is using Vertex AI and Gemini to personalize marketing campaigns.
- **Deutsche Telekom (DT)** is leveraging UneeQ's digital human customer service representative Max to help customers from sales to customer service and retention, driving a more holistic user experience. Earlier DT has used Selena, a digital salesperson, that reported a 5.8x surge in conversion rates, a 9% drop in cart abandonment, and a 47% increase in basket additions.
- **Salesforce** introduced Einstein GPT to refine customer relationship management (CRM). It interacts with LLMs by analyzing the full context of the customer's message and then autonomously the next actions.
- **Lenovo** has successfully implemented gen AI agents in software engineering and customer support, resulting in improved code production speed and quality by 10-15% and have addressed 70-80% of customer interactions without human intervention.

Impact

- Democratizing the use of AI. Development of natural interactions with agentic AI allows more technology uptake from all technical and non-technical backgrounds and lowers the barriers to access to AI technology.
- There is an acceleration on workforce AI upskilling enabled by more natural ways of working with new AI agents that speed up safe adoption.
- There is a rise of efficiency in completing tasks that were repetitive in nature with human-AI cooperation and interactions. Early adoption of it can be noticed in specific areas such as AI chatbots for analytics, sensemaking, and customer services resulting in time and cost savings.
- Facilitating and speeding up innovation. Organizational workforce can take advantage of huge data sources and through natural AI interactions with agents, develop new solutions in all type of industries that would not be within their reach otherwise.
- There's an acceleration of the development of AI ethics and AI safety skills within all types of organizations to ensure the positive role and benefits of interactions with AI agents and that they are built with transparency and assurance.
- Revolutionary innovations on human-AI interfaces through different channels (visual, sound, text, tactile, brain waves) allow for inclusive communication channels, increasing equitable access to AI interactions and developments so all humans can benefit from it and evolve with it.

Tech

- **Digital Human:** Meta, Google, AWS Q, Microsoft's Project xCloud, Unity, Soul Machines, Synthesia, Prins AI
- **Intelligent Agent/Advisor:** IBM Watson, Google, Salesforce, UNeeQ, Amelia, Nuance
- **Agentic Systems:** Open AI, Google DeepMind, IBM Watson, Microsoft Azure AI, AWS AI, C3.ai, NVIDIA, AgentOps.AI
- **Multi-Agents:** IBM Watson, Google, LeewayHertz, AgentForge, MetaGPT, AgentVerse, AgentOps.AI, Agency Swarm

Monika Underwood
Expert in Residence

You're Something Spatial

The convergence of spatial computing, digital twins, and real-time 3D is transforming industries with immersive, personalized, and sustainable experiences

Have we got something for you! Where digital layers interact with the physical, there's the magic of spatial computing — blending virtual data with real environments. Alongside digital twins and real-time 3D, it's revolutionizing industries by delivering immersive, real-time insights and hyper-personalized experiences. Whether it's optimizing factory floors, enhancing medical procedures, or reshaping smart cities, these technologies merge what we see with what we need to know. Large vision models and AI power this shift, giving machines the ability to both read and show the world. It all brings greater efficiency, lower costs, and smarter decisions. And you're not just witnessing this change — you're something special in driving it forward.

What

- Spatial computing, spatial web, digital twins, large vision models, and real-time 3D (RT3D) are at the forefront of the next digital revolution.
- These technologies merge the physical and virtual worlds, enabling immersive interactions through advanced visualization and intelligent systems. The spatial web, a new layer of the internet, links physical and digital objects, creating an interconnected system where real-time data is accessible in virtual environments.
- Spatial computing involves the overlay of digital information on the physical world, offering intuitive user experiences.
- Digital twins, virtual replicas of physical assets, provide real-time monitoring, simulation, and optimization of processes. Large vision models enhance machine perception, enabling devices to recognize and interpret physical environments.
- RT3D technology powers immersive simulations, enhancing industries from gaming to industrial engineering. Together, these advancements create an integrated digital ecosystem, transforming how we interact with technology across all domains.

Use

- **KLM Royal Dutch Airlines** harnessed Unity's XR technology to develop an advanced VR training application: the KLM Cityhopper VR Cockpit Trainer, to fully immerse trainees and enhance quality and customization of training scenarios.
- Surgeons at **GEM Hospital** in India have used the Apple Vision Pro headsets to perform laparoscopic surgeries. Through this, the doctors were able to get real-time transmission without delays, enhanced vision, and expert opinions using FaceTime, allowing surgeons to view surgery footage as well as CT scans simultaneously.
- **Regional Jet Center (RJC)**, part of the Air France-KLM Group, is harnessing spatial computing to revolutionize pre-flight damage checks. By integrating AR and digital twin technology, their new solution boosts efficiency by 900%, reducing flight delays while enhancing safety.
- **Dyson** inducted spatial computing tech in the consumer electronics segment with the launch of CleanTrace. It's an app equipped with advanced sensing technology for 'spatial cleaning', helping in identifying missed areas and providing proof of cleanliness directly on the phone in real-time using AR technology.
- **Sightful** has introduced the Spacetop G1, a laptop that merges traditional laptop functionality with spatial computing. Featuring a 100 inch virtual workspace instead of a standard 13 inch LCD, it's designed for enhanced productivity in a work from anywhere environment.

Impact

- The integration of these technologies drives significant efficiency gains, reduces costs, and enhances personalization across industries.
- Real-time monitoring and predictive analytics through digital twins minimize downtime and improve resource allocation, resulting in less waste.
- Personalized customer experiences in retail, powered by spatial computing, increase engagement and conversion rates.
- In healthcare, real-time data and immersive training tools reduce the risks associated with surgeries, leading to improved patient outcomes.
- Education becomes more accessible and effective through immersive learning environments, while manufacturing sees faster go-to-market and reduced operational errors.
- The overall reduction of energy consumption and physical footprint is a critical benefit, contributing to sustainability goals across sectors.

Tech

- **Real-Time 3D Engines:** Unity, Unreal, Panda3D, Enscape, NeoAxis Engine, Torque 3D, CryEngine 3
- **Spatial Vision:** NVIDIA, Intel, AWS, Qualcomm, Leap Motion
- **Spatial Web:** Meta, Google, Apple, Microsoft, Cesium, Mapbox, Unity, ESRI
- **Spatial Computing:** Unity, Matterport, NVIDIA, Microsoft, Meta, Apple, AWS, Qualcomm, PTC, Snapchat, ARway, Magic Leap, Rokid
- **Large Vision Models (LVM):** OpenAI, NVIDIA, Hugging Face, Google, Meta, Microsoft, AWS, Landing AI, Solulab

Jacques Bacry
Expert in Residence

Internet of Twins

Digital twins, virtual representations of real- world entities and processes, deliver better mastery of real-world challenges, with less strain on resources and energy

Definitely no evil twins involved here! Digital twins create ultra-realistic virtual replicas of real-world entities and operations, as close to the real experience as possible. As these twins become more sophisticated, they can be interconnected into an Internet of Twins, covering increasingly complex situations and interactions — including key aspects of human orchestration. From that growing insights, cognitive twins emerge, embedding decision-making capabilities into the virtual environment. These super twins can self-improve and operate autonomously — no longer just mirroring, but augmenting us in the real world. Just think of it as your trusty sidekick, minus the scary movie vibes.

What

- Let's consider the virtual replica (digital twin) as an object to represent the knowledge space of the physical object. The cognitive digital twin provides a knowledge space augmentation not only to extend the digital twin but also to improve the twin collaborations in a network. The more this collaboration relies on human artefacts, the greater the complexity.
- As humans, we are a social species and we need a certain level of interaction to function effectively. So, what are the appropriate means of communication in virtual environments? Moreover, we all implicitly and instinctively use non-verbal communication, so how should we represent these non-verbal signs in virtual environments? Self-identification in the virtual environment, such as extending the representation of the user through avatars, is key for psychological identification. There are numerous academic research examining these issues. However, there are still many unanswered questions surrounding key topics, for example how to ensure the identity of virtual individuals for the emotional connection and seamless interaction with the same level that you can expect in the real world.
- The initial focus should be to federate all relevant data in using the regular digital twin, in terms of process (or organization), or in establishing the right connection to the dedicated twin. In this case, all the technologies used to identify the right data (AI) and/or to manage the right twin interoperability (ontologies) will be useful.

Use

- **IES** has used its digital twin technology to create a digital replica of the 40 most energy-intensive buildings at Brussels Airport. The technology has demonstrated the most effective routes to reach net-zero emissions by 2030, reducing the airport's initial target of net zero by 2050.
- The **Horizon Europe** supported TwinEU project is an adaptable federated digital twin ecosystem spanning over three different layers, namely an adaptive twins federation layer, a dataspace-enabled data and models sharing infrastructure and the service workbench. It will demonstrate digital twins tools in eight pilots across 11 EU countries to ensure replicability in different geographical and market settings with a wide variety of use cases.
- **Endesa**, a Spain-based electric utility company, has developed digital twins of its El Pintado hydroelectric plant to carry out 3D virtual visits and preventive evaluations to analyze the performance of these facilities. Endesa has implemented digital twin models for diagnosis in their 38 main hydroelectric plants, covering approximately 70% of the total installed capacity.
- **Taiwan Central Weather Administration (CWA)** has leveraged NVIDIA's Earth 2, a digital twin of the planet's climate, to simulate and visualize weather and climate at an unprecedented scale. Using the advanced AI digital twin models, CWA hopes to predict the weather more accurately to gage where typhoons will hit next.
- **Louisiana State University (LSU)** and Sev1Tech, using Unreal Engine and Perforce Helix Core, are creating digital twin of NASA's Michoud Assembly Facility in New Orleans using real-time technology. This digital twin enables NASA to create data-driven models that replace time and cost intensive real-world design testing.

Impact

- A crucial research question relating to the digital transformation of companies concerns the learning process in an immersive environment, and how such processes should be improved with the support of humans.
- Another key challenge is how to measure the incremental added value and benefits of using digital twins environments, both in the short and long term. Many sensors already exist for gauging quantitative biophysiological and cognitive factors in the real world, but their application in the virtual world is still lacking. Once the data gets retrieved, both in streams and stored in permanent stores, data analytics can be performed, followed by ML/DL model generations.
- In creating virtual environments, it is highly likely that the user will need to make decisions such as requiring technical help or choosing between design options. We need to determine the influence of the different factors that will be involved in both real and virtual decision-making processes. We also need to consider the relationship between the real and virtual, and the impact of decisions made in the digital processes on peoples' reality. This convergence between digital and people enables cognitive digital twins to adapt proactively to varying conditions and anticipate future scenarios. It also provides a way to optimize industrial processes and embody the ideals of resource efficiency and environmental sustainability from a human-centric perspective.

Tech

- **Digital Twin Platforms (generic):** Matterport, Microsoft Azure, AWS, IBM Digital Twin Exchange, Siemens, Bosch, Oracle, Dassault Systems, ANSYS, PTC, COSMO TEC, NavVis, General Electric, ABB, Blackshark.ai
- **Cognitive Digital Twin:** Digital Twin Consortium
- **Digital and Cognitive Twins:** ICT4SM - EPFL: Digital & Cognitive Twins - ICT4SM - EPFL
- **Cognitive Twins for Supporting Decision-makings of IoT Systems:** arxiv.org

Krystianne Avedian (She/Her)
Expert in Residence

I Feel for You

Enabling and empowering individuals, teams and organizations by creating a more effective, meaningful, and impactful integration between people, their emotions, and technology enablers

As tech edges closer to human smarts, Emotional Intelligence (EI), also known as Emotion AI or Affective Computing, bridges an important gap. By decoding our quirks like facial expressions, tone, and body language, EI gives technology the charm to personalize every interaction, boosting loyalty, engagement, even gamifying our experiences. With this EQ upgrade, systems can make decisions and take actions that 'feel' right — almost. But as algorithms learn our moods, ethical lines blur; balancing personalization with privacy and ensuring emotional data is handled responsibly are key to keeping things, well, not too creepy. But done well, it's more than a feeling. Technology, I think I love you.

What

- Empathy and emotional intelligence work together, enabled by caring, to produce long-lasting relationships and this is even more so true for building relationships across technology platforms, be it B2B, B2C or employee experience. As organizations and leaders are redefining their ways of working in the modern workplace, empathy is in short supply, now more than ever. However, organizational empathy is moving beyond customer centricity and adding employees to the equation to drive business success. CX and PX/EX are now the top priorities across all organizations. The focus is on the collective capacity of an organization to demonstrate empathy to all stakeholders, as well as a commitment to develop an understanding of customer needs.
- Emotion AI offers new insights to understand people and customers. Industries are finding ways and identifying areas to integrate emotional intelligence, such as chatbots, virtual assistants, and facial recognition.
- Voice-enabled AI technologies actively monitor a user's voice to check emotional well-being through unique vocal biomarkers and predict core symptoms of mood and anxiety disorders: depressed mood, diminished interest, avoidance, and fatigue.
- However, Emotion AI requires transparency. For Emotion AI to work and not have the opposite effect, it is crucial to communicate digital ethics and values through humane responsibilities and be transparent about what data is collected, for what purpose, with what access rights, and how long it will be stored.

Use

- **Thumos Care**, a healthcare technology company, uses Hume's Empathic Voice Interface (EVI), a HIPAA-compliant conversational voice AI with emotional intelligence, to facilitate conversational explanations and assist in healthcare plan creation and adherence.
- **WHO** introduced its gen AI health assistant with enhanced empathetic response, S.A.R.A.H., a 24/7 digital health promoter prototype, available by video or text in eight languages, trained with biological artificial intelligence and multimodal cognitive model to provide health information, including mental health resources.
- Researchers at the **Karlsruhe Institute of Technology (KIT)** and the **University of Duisburg-Essen** have trained a new emotion analysis model based on AI with data from actual games to accurately identify affective states from the body language of tennis players during games. The AI model assesses body language and emotions with accuracy similar to that of humans up to 68.9%.
- **Mount Sinai Health Care** and IBM Research are working on the Phenotypes Reimagined to Define Clinical Treatment and Outcome Research (PREDiCTOR) study to use AI tools and behavioral data from clinical interviews, at-home data captured on smartphones, and cognitive testing to improve mental health care for young people.
- **UK's National Robotarium and the AIT Austrian Institute of Technology** developed VITALISE project, where robot coaches read brain signals and pave a new way for the rehabilitation of stroke and brain injury survivors.

Impact

- There are broad reaching impacts of EI with AI including enhanced human-AI interaction, improved mental health support, enhanced educational tools and better healthcare outcomes with the right use of AI technologies.
- Companies are leveraging Emotion AI when training call-center and tele-sales employees. AI analyzes the quality, tone, and pace of the individual, and trains them to speak with more empathy, confidence, professionalism, and efficiency where needed.
- AI-based approaches can easily detect human expressionism, such as joy, surprise, fear, or anger, but will soon recognize traits such as age, race, and gender to understand social dynamics, bringing more personalized experiences to consumers — without bias.
- Ion recognition technology is being used widely to bring benefits in many areas, including health, anti-terrorism, urban security, and road safety.

Tech

- **Emotion AI in Learning:** Entropik, Proctortrack, LOVO AI, Vier AI
- **Employees Management:** EI Experience, TeamEQ, Amber, Lead Honestly, InsideBoard
- **AI to Build Resilience:** Driven, Resilient AI, Resiliency
- **Emotional Analysis:** TypingDNA, Emokit, NVISO, Element Human, Receptiviti, CompanionMX
- **Facial Analysis:** smileML, Affectiva, Amazon Rekognition, Microsoft Face API, Facia.ai
- **Driving AI:** drivebuddyAI, Affectiva Automotive AI
- **Retail Solutions:** Lily AI, Entropik, madstreetden
- **Language Analyzers:** Watson Tone Analyzer, Emoshape (MetaSoul), Cogito, Amazon Connect, Modulate-ToxMod
- **AI-Driven Sentiment Tools:** Lexalytics, ParallelDots, Brand24, OpenText, Qualtrics XM Platform

Nitin Dhemre
Expert in Residence

No Experience

AI and immersive tech drive controller-less interactions in a merger of physical and virtual worlds, bringing a natural, intuitive, and stress-free experience of technology; like there is no experience at all

What if technology could just get what we want, without needing to use 2D touchscreens, buttons, and controllers? What if we could just talk, look, point, and gesture in a spatial environment, much like we interact in the real world, moving seamlessly between the virtual and physical? High-quality rendering, powerful real-time graphics engines and immersive displays make us feel physically present in virtual worlds, and vice versa. Combined with the power of AI, these technologies create an experience that doesn't even feel like an experience anymore. We'll be guided by multi-talent virtual agents — only a few words or a gesture away — that understand our preferences and personalities. They'll deliver personalized experiences, services, insights, and actions, seamlessly blended into our 'real' lives. A no-brainer indeed.

What

- 'No experience' or 'zero user interface' is a trend that we have been seeing in the past few years. Solutions such as voice assistants, face and biometric identity, smart speakers, fitness trackers, virtual reality glasses, and smart home systems are harbingers of this new era.
- For input and control of digital interfaces, voice and natural language processing are becoming more advanced and easier to use. Going further, gesture and body tracking are reducing the need for a physical interaction interface. Further out, brain-computer interfaces hold the potential to control technology with our thoughts, eliminating the need for touchscreens, keyboards, etc.
- The use of generative AI for the creation of hyper-realistic virtual agents with personalities and preferences, as well as building high-definition and adaptive immersive experiences represents a step change in efficiency, accuracy, speed, and cost-optimization compared to traditional approaches.
- High-definition real-time 3D engines and GPUs allow realistic rendering of light and volumes, hyper-personalized and customized to adapt to each user's unique environment and situation. AR and MR technologies blur the boundaries between the real and virtual.
- Future interfaces are expected to be highly context-aware, understanding the user's environment, preferences, and needs. As AI and automation continue to advance, systems will become more autonomous, making decisions, and taking actions on behalf of the user.

Use

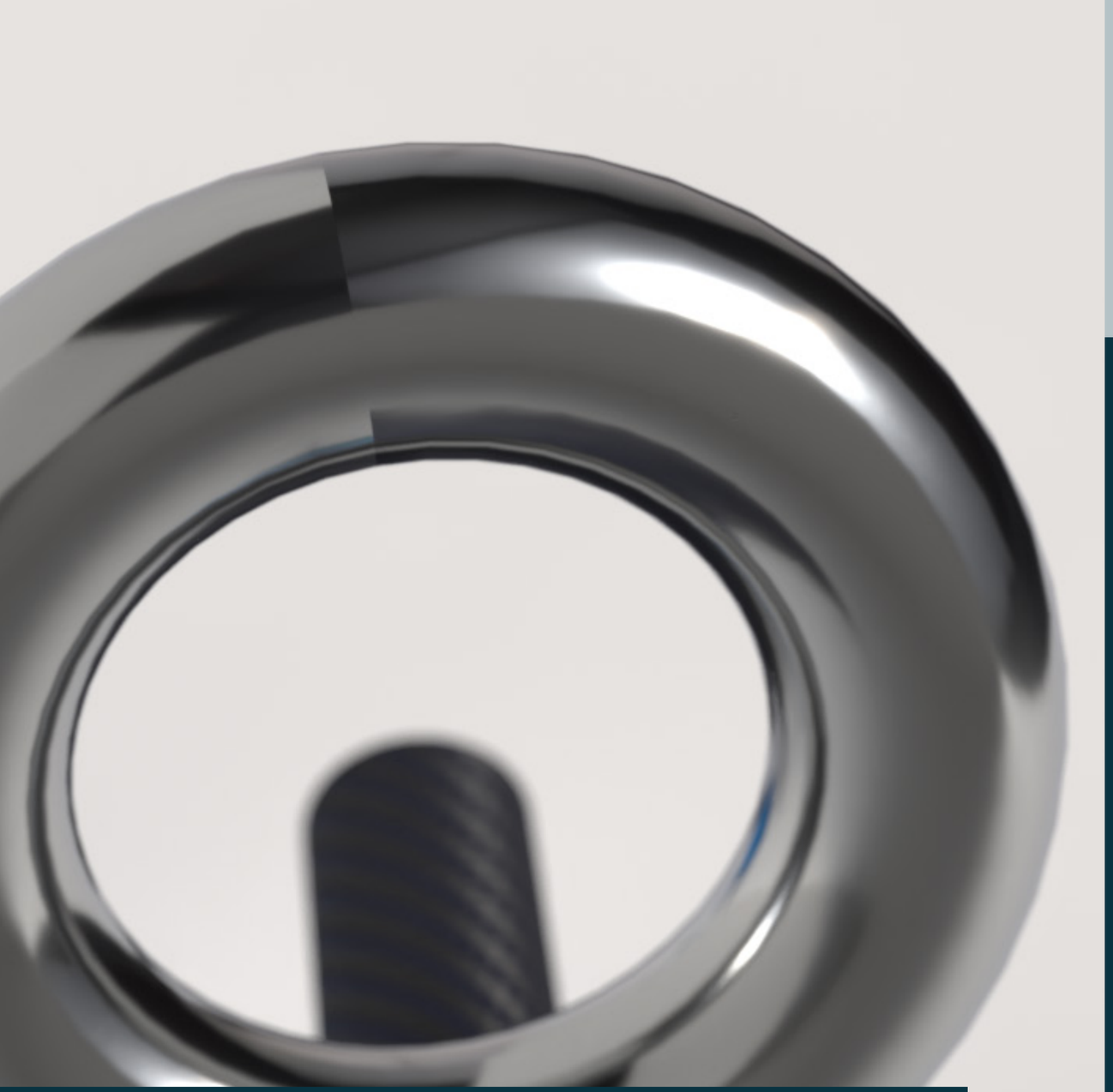
- **Meta** showcased AR glasses prototype 'Orion,' a wireless spatial computing device with a 70-degree field of view, silicon carbide lenses, uLED projectors combined with natural inputs and added electromyography (EMG) technology — all in a worn wristband.
- Doctors from the **Saint-Augustin Urological Group** have performed a remote transcontinental telesurgery from the Saint-Augustin clinic in Bordeaux on a patient in Beijing, more than 8,700 km away, using a 'Edge Medical' console.
- **Wearable Devices**, an AI-powered touchless sensing wearables provider, has unveiled an innovative interaction process where users can seamlessly interact with ChatGPT, directly from their Apple Watch. It's done using the Mudra Band, the company's innovative AI-powered neural input interface.
- The researchers of **Tsinghua University**, China, has created the 'Agent Hospital' in the virtual world designed to treat 10,000 patients in a few days, where all doctors, nurses, and patients are controlled by intelligent agents powered by LLMs that can interact autonomously.
- **Spotify**, a global digital music service provider, has leveraged Sutherland Translate AI — an AI-driven, real-time translation platform, to its customer service capabilities in new and existing markets, leveraging cognitive AI for measurable business results.

Impact

- The seamless blending of real-world and digital experiences will drive immense change in the digital customer experience space, redefining the standards of interacting with technology.
- Automated intelligent characters guiding us through our digital lives will have a profound impact on user behavior. As all our needs will be met by simply talking to a digital character, we won't need to visit existing web platforms.
- On the commercial side, offers across categories will be combined and bundled, focusing on the holistic consumer need rather than the marketing and sales strategies of brands.
- New kinds of consumer data will be available to be leveraged by companies, including social interactions, interests and preferences, behaviors, etc.
- Data security and privacy will become more important, as such sensitive data in the hands of malicious actors can have profound consequences.

Tech

- **Spatial Computing:** Unity, Matterport, NVIDIA, Deere, Microsoft, Meta, Apple, AWS, Qualcomm, PTC, Snapchat, ARway, Magic Leap
- **Gen AI and Virtual Worlds:** NVIDIA GET3D, Roblox, OpenAI Point-E, Hiber3D, Meta, Stability.ai, RunwayML, NVIDIA FlexiCubes, Nextech3D.ai, 3DFY AI, OpenAI Shap-E, DreamFusion, Luma AI, Gsgen, Hugging Face
- **Gestural Interaction Technology:** Ultraleap, Vuforia, Shopify, Meta, Pico, Apple, HTC
- **BCI:** Blackrock Neurotech, BrainGate, ClearPoint Neuro, Neuralink, Synchron
- **Real Time 3D Engines:** Unreal, Unity, Panda3D, Enscape, NeoAxis Engine, Torque 3D, CryEngine 3
- **Projection Mapping:** Lightform, HeavyM
- **Natural Language Translator:** DeepL, Google Translate, Microsoft Translator, Yandex Translate, QuillBot, Amazon Translate



We Collaborate

Sudhir Pai
Expert in Residence

Where We Are

Collaboration and connection are finding their groove, shifting from rigid hierarchies to lightweight, adaptive, mesh-like ways of working, more like a jazz combo jamming together than a formal orchestra. With hybrid work now the headliner, digital workplaces have gone from 'nice to have' to an essential part of the act, though only 29% of employees are vibing with the current tools. Enter AI copilots: taking collaboration from basic co-creation to full-on co-thinking, slashing operational effort by up to 71%, and riffing on customer experiences like never before.

At the heart of this jam session is digital identity — a cornerstone of trust, privacy, and fresh collaborative models. EU-backed standards like verifiable credentials are building trust bridges, turning seamless global interaction from a pipe dream into reality. Interoperability keeps the groove alive, breaking down barriers and enabling frictionless, borderless value exchange through initiatives like SWIFT and BIS Project Agora. Agile platforms hold it all together, the connective tissue that lets industries improvise, adapt, and thrive in this ever-changing, interconnected world. Collaboration? It's less of a solo and more of a jam.

Balancing Act

Collaboration technologies are caught in a constant juggling act between innovation and real-world demands. Businesses are evolving from assisted to fully autonomous models, where balancing cost with value and experience becomes critical. Machine customers, agents, and automated workflows are taking the lead, but a human in the loop remains essential to ensure resilience, trust, and data privacy. The promised value of autonomy must counterbalance risks and the need for robust regulation to protect both workers and customers. Meanwhile, the tug-of-war between decentralized and centralized models demands careful navigation of trade-offs: value versus risk, speed versus security, and identity versus privacy.

New Trends

The newly introduced trends in the **We Collaborate** container show exciting, fresh approaches to collaboration and teaming, while also being indicative of some of its conflicting forces and dynamics:

- **Autonomous Agent Alliance.** As businesses embrace autonomy, machine customers and intelligent agents are stepping up as key collaborators. Yet, the secret sauce remains the human touch which is essential for building trust, safeguarding privacy, and ensuring resilience. It's less about replacing humans and more about crafting a seamless alliance between minds and machines.
- **Synergy².** The future of work thrives on synergy: human creativity paired with AI-assisted tools and automation. This partnership optimizes tasks while empowering workers to focus on innovation. Balancing virtual and physical workplaces becomes key, blending the flexibility of remote collaboration with the richness of in-person connection to create truly adaptive workflows.

3 Steps to Take

1. **Empower the augmented workforce.** Embrace the fusion of human creativity and AI assistance by equipping teams to collaborate with digital peers and automated systems. Focus on dynamic upskilling and fostering adaptability. Move beyond traditional training — explore immersive learning, gamified reskilling, and ethical AI principles to ensure your workforce thrives in this new collaborative era.
2. **Rethink enterprise boundaries.** Shift from static structures to agile ecosystems where products and services integrate ethics, privacy, and security by design. Experiment with decentralized models and AI-driven innovation, while ensuring regulatory readiness. The key is embracing a culture of continuous reinvention to stay ahead in a world of fluid, boundary-pushing possibilities.
3. **Redesign collaboration from the ground up.** Collaboration must evolve to match hybrid realities. Build ecosystems that prioritize real-time interaction, digital identity, and seamless data exchange. Explore new paradigms like agentic systems, decentralized decision-making, and human-AI co-creation to unlock collaboration that's not just frictionless but transformative, wherever work takes place.

Keerthi Anantapur Guggila
Expert in Residence

My Identity, My Business

The rise of decentralized identity management, powered by next-gen technologies, will empower individuals to reassert control over their own data in an ever more complex, digital network

It's easy to get lost or forget who we are when navigating the complex jungle that online ecosystems are nowadays. Cue decentralized identity: firmly founded on distributed technologies such as blockchain and zero-trust security, it thrives on federation, rather than demonizing it. With tools and technologies like self-sovereign identity and smart contracts, we're rewriting the collaborative script, placing the control firmly back in our hands. Businesses will not only save money by cutting down on identity theft but will also build customer trust like never before. Sounds like we're in business.

What

- Blockchain remains a crucial technology for decentralized identity systems, enabling secure and verifiable identity management by creating immutable records that do not rely on a centralized authority.
- As cyber threats grow more advanced, the zero trust security model is becoming increasingly popular. Identity and access management (IAM) solutions are expected to adopt zero trust principles more widely, ensuring that access is continuously validated at every stage.
- Artificial intelligence (AI) and machine learning (ML) are set to revolutionize identity and access management by facilitating real-time decision-making and adaptive authentication methods. Leveraging AI-driven analytics, these systems will proactively identify and address potential threats, fortifying IAM defenses against cyberattacks while improving overall security.
- Password-less authentication, which uses biometrics, hardware tokens, authenticator apps, QR code scanning, email-based authentication, is set to become the standard method for securing user identities. This transition will not only strengthen security by eliminating password-related vulnerabilities but will also enhance the user experience by offering a more seamless and secure login process.
- The adoption of decentralized identity solutions by enterprises is rapidly increasing, along with efforts to standardize these systems. This growth aims to reduce identity fraud and enhance authentication processes by streamlining how identities are managed and verified.
- The interplay between decentralized identity management and regulatory compliance is expected to intensify as business and governments push for more transparent, secure, and user-centric data management solutions.

Use

- **Protectoria Venture**, a Norway-based digital ID provider, launched PV IDaaS, a decentralized platform offering secure, interoperable identity services based on self-sovereign principles. The platform empowers governments, businesses, and civil society to manage digital interactions with trust, driving global digital transformation and efficiency.
- China's **Blockchain-based Service Network (BSN)** launched RealDID, a Decentralized Identity (DID) service to verify real-name identities for 1.4 billion citizens. RealDID supports applications like authentication, encrypted transfers, privacy-protected logins, and custom business DID services, enhancing privacy and security, particularly for Web3.
- **fliggs mobile**, in partnership with T-Mobile, launched an all-digital Web3 mobile virtual network operator (MVNO), integrating a non-custodial wallet for decentralized ID cryptocurrency payments, and Web3 FinTech services. This gives customers greater control over their data and enhances privacy in digital transactions.
- **NatWest Bank** has adopted OneID's bank-verified digital identity solution for its structured finance operations in Sweden, Finland, and Norway. This enables online banking users in these countries and the UK to securely verify their identity before signing leasing agreements, offering a more efficient and secure process.
- **HSBC Trusted ID** provides a secure identity foundation, enabling individuals to access various services and promoting financial inclusion by allowing children and dependents to participate in the digital economy through a parent or guardian's trusted ID.

Impact

- Enterprise adoption of decentralized identity solutions will mitigate identity fraud and streamline authentication processes. Organizations can eliminate the need to store user data, significantly reducing security risks.
- Small businesses can not only improve their security and operational efficiency but also foster stronger relationships with their customers through enhanced privacy and trust.
- Standardization of decentralized identity systems will ensure that decentralized identities are portable and interoperable across different platforms, facilitating broad adoption.
- Users will develop greater trust in online services. The transparency and security offered by DIM can help users feel more secure in sharing their information, fostering a healthier digital ecosystem.
- The ability to manage user consent and control data access will help organizations avoid hefty fines while building a reputation for ethical data management.

Tech

- **Decentralized Identity:** IDunion, IBM Blockchain Trusted Identity, Trinsic, 1kosmos, Gataca, AU10TIX , Fractal ID, SpruceID
- **Self-Sovereign Identity (SSI):** Okta, Infopulse, Walt.Id, Evernym, Protectoria, Cheqd, Trasna
- **Web3 Identity Management:** Fractal ID, Privado ID, Galxe, BrightID, Verite, WIW, ONT ID, iden3, SPACE ID, Compilot
- **Digital Wallets:** Thales, IDnow, ID.me, AuthenticID, Identyum ID Wallet, GoodID

Rajesh S. Iyer
Expert in Residence

Autonomous Agent Alliance

Collaborative autonomous AI agents are taking over the heavy lifting in business operations, adapting and learning on the fly

Every mission (possible or impossible) needs the right agents — sometimes undercover, sometimes out in the open. As businesses embrace autonomy, intelligent AI agents are stepping up as key collaborators, tackling challenges with adaptability and focus, while continuously learning and evolving. Yet, the secret sauce remains the human touch which is crucial for building trust, safeguarding privacy, and ensuring resilience. It's not about replacing humans; it's about crafting a seamless alliance between minds and machines. Your secret agents soon may not be that undercover anymore.

What

- Agentic systems represent the next generation of automation, intelligently breaking down complex tasks into organized steps and executing them by coordinating existing digital tools and services. Unlike traditional automation that follows fixed rules, these systems understand goals and orchestrate resources to accomplish them.
- When analyzing portfolio risk, for example, these systems determine and sequence all required steps automatically. They coordinate the gathering of data, pull market indicators, apply risk models, validate against compliance requirements, and generate reports, ensuring each step flows naturally into the next.
- Adaptation is central to their operation. When faced with obstacles, whether missing data, system outages, or unexpected conditions, they adjust their approach by finding alternative data sources, rerouting workflows, or reorganizing task sequences.

Use

- At **CBW Bank**, Edge AI creates a world where tasks like interest rate queries, account openings, fund transfers, and payment reminders simply happen — autonomously, biometrically approved, and utterly seamless.
- Khanmigo of **Khan Academy** is an agentic system that autonomously supports educators and students. It dynamically breaks down complex educational goals into actionable tasks, such as generating personalized lessons, offering real-time tutoring, and adapts to feedback.
- **Wellspan Health** uses an agentic system from Hippocratic AI to screen and reach out to patients eligible for colon cancer screenings, make appointments and make follow-up calls until the time of the procedure.
- Moveworks' agentic AI copilot powers **Broadcom**'s 1.Bot to resolve over 57% of employees' IT issues autonomously, without service desk intervention. Additionally, it integrates scattered knowledge bases into a single interface allowing employees to quickly find solutions via Google Chat, reducing the IT team's workload and enhancing efficiency.
- **Moneyview** leverages Ema's agentic AI to automate customer support, improving service for their diverse user base. With over 45 million app downloads and $1.4 billion in loans disbursed, they automated 70% of support tickets in multiple languages, reducing costs and ensuring faster resolutions.

Impact

- Operational agility can reach new levels as systems adapt to changing conditions in real-time while improving their performance through continuous learning. While responses to market changes are faster, this heightened interconnectivity can amplify the impact of any system failures.
- Security and control considerations become increasingly critical as operations become more interconnected. While automation can reduce routine, system failures can cascade rapidly through operations.
- Online banks are reporting significant impact from agentic systems. AI agents are being used to handle up to two-thirds of all customer interactions. Repeat enquiries can be cut by 25%, all of which can result in millions in profit boosts.
- In the space of digital marketing, agentic AI is seen to improve marketing ROI by 30x, in essence enabling one person to do the work of 30 at a tenth of the cost. Average customer time to value has seen a drastic decrease as well, demonstrating the transformative power of agentic AI in creating personalized, scalable marketing content.
- Healthcare providers can use gen AI to streamline clinical documentation. AI agents can be used to record patient interactions and generate summaries for electronic health records, reducing administrative burdens. In a two-month pilot at a US firm, clinics showed a 78% reduction in cognitive load, a 40% drop in burnout of the workers, and a 41% increase in time spent directly engaging with patients.

Tech

- **At the Edge:** Waylay, Rabbit, Kneron, Edge Impulse
- **Decentralized:** Fetch.ai Ocean Protocol, SingularityNET, Haja Networks
- **AI and Robotics:** Osaro, Agility Robotics, Vicarious, Covariant
- **Financial and Enterprise:** Eigen Technologies, Clara Analytics, Quantifi
- **AIOps:** Seldon, Grid.ai, Databand.ai, Opsani
- **Conversational:** Kore.ai, PolyAI, Replicant, Rasa, Avaamo

Melissa Swift
Expert in Residence

Synergy²

The new workplace combines human creativity and insight with technology, balancing virtual and physical means into a powerful mix

The future of work thrives on a partnership that multiplies potential — where human creativity and technology tools amplify each other to achieve more than before. AI and advanced collaboration technologies are reshaping this dynamic, enabling humans and their digital colleagues to work side by side, boosting productivity and unlocking new possibilities. Balancing virtual and physical workplaces is essential, blending the flexibility of remote collaboration with the richness of in-person connection to create adaptive workflows. Of course, this partnership isn't without its challenges — but when done right, it doesn't just add up; it exponentially transforms what work can be, proving two heads (even if one's digital) are better than one.

What

- The human workplace has never been so technology-saturated, for better or worse. Research suggests that we toggle between different technologies thousands of times a day. Why? Because a host of collaboration technologies now support real-time synchronous communication and provide platforms for better asynchronous work, while gen AI dangles the promise of real thinking support.
- Collaboration tools are having a moment. Gartner estimates that their use has risen 44% in recent years — partly fueled by greater remote work. A Microsoft study found that 85% of workers found these technologies to be 'a critical area of focus,' and academic researchers now cite their use as a critical component of digital literacy .
- We are also seeing clients jump into the gen AI journey at pace. Research from the Capgemini Research Institute (CRI) shows that 80% of organizations have increased their investment in gen AI since last year. CRI research on software engineering indicates that 61% of leaders believe gen AI use enhances creativity.
- Working collaboratively in an era of tech saturation means 'high highs and low lows.' Highs: it's never been easier to know what co-workers are thinking in real time, or to spark creativity with thought starters from gen AI. Lows: it's never been easier to be interrupted...or to find yourself drowning in questionable information.

Use

- **JPMorgan Chase** launched LLM Suite, a generative AI assistant, to 60,000+ employees. It connects users to external models like OpenAI, aiding in tasks such as email and report writing.
- **Zoom** introduced Zoom Docs, an AI-powered collaborative tool in its paid Workplace plans. Integrated with Zoom AI Companion, it offers content generation, real-time co-editing, multilingual translation, and customizable permissions to streamline team workflows.
- **Swiss Re** deployed Copilot for Microsoft 365 for HR, communications, and business operations to boost productivity through automation, while ensuring compliance with data security standards.
- **UKG**, a US-based HR, payroll, and workforce management solutions provider is integrating Google Cloud's generative AI into its human capital management (HCM) suites, combining UKG's AI models with Google's LLMs to improve employee engagement and provide enhanced business insights.
- **ntv.de**, an **RTL** brand, a Germany-based news portal, collaborated with ML6 to develop a solution that completes the editorial production process using LLMs. The solution helped streamline the editorial process by reducing the time an editor spends searching for a topic and suggesting text elements that save time per article and benefit time-to-publish.

Impact

- Collaboration tools are enabling a world where across many professions teams can spend almost half their day working together which can be a huge boost to innovation and engagement. Online collaboration tools allow connections to be near-instantaneous, a perfect parallel to in-person workforce collaboration activities.
- On the darker side though, the proliferation of collaborative technologies has packed the working day full of mentally taxing task-switching. One study estimated that knowledge workers toggle between apps an astonishing 1,200 times a day, causing tremendous mental strain.
- Today gen AI jumpstarts work through inexpert but directionally helpful contribution. Time will tell if it can 'get promoted' to a full collaborator. Positive impacts for today's work include faster starts and quick aggregation of information, allowing for faster and more insightful delivery of service. On the flip side, care must be taken to accurately spot and fix hallucination and false positives.

Tech

- **Meeting Assistants:** Copilot for Microsoft 365, Zoom AI Companion, Otter.ai
- **Productivity and Collaboration Tools:** Asana, Slackbot
- **Workflow Automation:** Relevance AI, Boost AI
- **AI-Powered Assistants:** IBM WatsonX, ML6 AI Co-Workers

Neha Punater
Expert in Residence

Your Business is a Mesh

Enabled by efficient decentral 'mesh' technology, organizations can join forces, even if it's only on the fly, just for one day, for one occasion, or for one customer

Caught in a mesh? Businesses can no longer just be digital but must become living, learning, and adaptive. With AI, agile applications, deep connectivity and decentralized tech, it is easier and more efficient than ever to collaborate with others. Always-evolving, ecosystem-based business models drive unique products, services, and customer experiences that were deemed impossible before. They can cross the barriers of enterprises, industries, and regions. Mesh collaboration enables businesses to see, predict, and adapt to market needs and circumstances in real-time and maybe just for a moment. Exactly what the rumble organizations are looking for.

What

- Developing the necessary infrastructure and platforms needs a collaborative approach among industry stakeholders and technology providers, ensuring that all parties work together to establish a cohesive ecosystem. This collaboration enhances interoperability and promotes innovation whilst prioritizing the protection of sensitive information, creating a secure environment for all users involved.
- Organizations must embrace responsible and collaborative innovation to comply with relevant regulations such as General Data Protection Regulation (GDPR) and Payment Services Directive 2 (PSD2), and safeguard consumer rights. By working together and prioritizing ethical considerations, they can ensure that their innovations are in line with public interests and legal standards.
- Global frameworks and regulations like the EU AI Act, which will be enforceable by August 2026, will help establish a broad set of obligations aimed at ensuring system resilience, robust data governance, and enhanced security measures to protect consumer information.
- Standardized platforms enabling seamless exchange of information should be established adhering to relevant guidelines for data sharing, integrity, and security. For example, in healthcare, Open APIs can facilitate better integration between hospitals, laboratories, and insurance providers, allowing for streamlined patient data sharing, enhanced coordination of care, and improved overall patient outcomes.
- Hyperscaler solutions like Google Cloud Platform, AWS, and Microsoft Azure offer strong data governance, security features, and compliance with relevant frameworks, ensuring data integrity, availability, scalability, and cost efficiency while providing access to advanced technologies.

Use

- **X-Road**, a decentralized data exchange platform developed by Estonia facilitates cross industry collaboration for efficient and secure data exchange. It achieves data privacy and security using string encryption and authentication methods. X-Road connects different data sources directly, enhancing resilience and reducing the risk of single points of failure. Its design supports encryption, digital signatures, and robust legal frameworks.
- Financial institutions are experimenting the concept of a shared infrastructure to provide a unified view of balances across all the shared ledger's participants, with real-time visibility. Combined with tokenization, this could offer instantaneous movement of value and atomic settlement for transactions, reducing the need for reconciliation. **BIS' Finternet** and **MAS' Global Layer 1** are some of the promising initiatives in this regard.
- **The Telefónica Network API** is a venture established by major telecom operators to combine and sell network APIs to promote interoperability across sectors. It will enable innovative use cases such as anti-fraud verification for financial transactions, the ability to check device status so streaming providers can dynamically adjust video quality, and real-time healthcare data sharing.
- **Centers for Disease Control and Prevention (CDC)**, a US government healthcare agency is implementing data modernization by improving data collection, integration, and analysis. These initiatives aim to facilitate quicker detection of health threats and enable more effective responses. This will be achieved using electronic case reports (eCR), which will enhance data interoperability and advanced analytics. The public healthcare data will be shared with healthcare systems and providers using Trusted Exchange Framework and Common Agreement (TEFCA) to enable quicker action to respond to health threats.
- VTAP, Visa Tokenized Asset Platform, is **Visa's** initiative to simplify the issuance and management of tokenized assets. Various assets such as currencies, real estate, digital collectibles will be represented as digital tokens on a blockchain, enhancing the efficiency and security of transactions, making asset management more efficient and accessible in the digital age.

Impact

- Common infrastructure platforms enhance adaptability and scalability across various industries and regions, allowing for a greater array of use cases while ensuring adherence to relevant security standards. This also fosters innovation among providers to offer newer and more efficient services and applications.
- These frameworks and solutions support more efficient and secure data sharing in a digital environment, promoting collaboration while maintaining data sovereignty. This helps build public trust in digital governance.
- A comprehensive risk management framework across interconnected components of a digital ecosystem helps to address risks along with cybersecurity and resilience. It helps to define a methodical approach to prevent or mitigate the risk.
- Clearly defined oversight frameworks for cross-industry collaborations can build trust in data governance and digital resilience, while also enabling exploration of ways to enhance existing regulations and frameworks for more efficient future collaborations.

Tech

- **Data Sharing:** Cassie, Hammerspace, Vendia, AWS Data Exchange, Snowflake, iGrant.io
- **Blockchain and API:** Covalent, Helius, Mnemonic, Hyperledger, Ethereum, IBM Blockchain, Tributech
- **Identity and Access Management:** 1Password, Socure, Transmit Security, Truiloo
- **Artificial Intelligence and Internet of Things:** Kontakt, IBM AI, Google AI Platform, IOT, Microsoft Azure IoT Platform, Google Cloud IoT Core, AWS IoT, Affectiva, Realeyes
- **Other Technologies:** Codefi, IBM Watson, Microsoft Azure, Microsoft HoloLensIs, MindSphere, OpenAI, TensorFlow

Muhammed Ahmed
Expert in Residence

Economy of Things

When physical assets and 'things' become part of business networks, entirely new economic models are on the horizon

Things aren't what they used to be. With every human, machine, and object carrying its own sovereign digital identity, new interactions flow seamlessly in a decentralized, interconnected ecosystem leaving no 'thing' behind. Powered by the IoT, distributed ledgers, AI, and deep connectivity, new economic models thus redefine collaboration, innovation and value creation. To make it all work, balancing is essential though. But when we successfully navigate the complexity levels of this yet unheard economy, things could turn out to be everything.

What

- The economy of things is the next frontier of technology convergence, where the synergistic impact of technologies (IoT, DLT, AI, digital twins, 5G, Web3) can create unprecedented value and impact.
- Connected devices, decentralized identity, intelligent agents, smart contracts, and distributed computing all work hand in hand to enable the economy of things, where objects, things or tokens can identify themselves and transact in a secure manner.
- Machine customers present a massive opportunity for enterprises, with the number of connected products and devices estimated to surpass 15 billion by 2025, and contribute to up to 20% of revenue by 2030.
- Tokens can represent any asset, tangible or intangible, and its ownership in digital medium. Currency, assets, goods, art, identity, votes or carbon credits — tokens are everywhere today, fundamentally influencing the way we transact and trade.
- Interoperability will be a key driver for scaled enterprise adoption of decentralized and connected technologies. It will connect a fragmented ecosystem, streamlining liquidity in the global financial landscape, as well as enabling seamless straight-through processing via connected devices.

Use

- Tokenization is finding institutional adoption with real-world use cases, especially in the financial services sector. Several banks have rolled out token services, including **Citi**, **DBS**, to unlock instant, 24/7 real-time settlements. Payment service providers are also pioneering innovation in this space through new platforms and services (e.g., **JP Morgan**, **Visa**, **PayPal**).
- 94% of the central banks worldwide are exploring a CBDC (Central Bank Digital Currency), with countries like China in advance stages of roll-out and other major regions embarking on large programs of work (e.g., Digital Euro), while several initiatives are being aimed at improving cross-border payments (e.g., **Swift**, **Project Nexus**, **Project Agora**, **BRICS Pay**).
- Tokenization is enabling digital ownership and fractionalization of assets in other sectors. Examples include Energy (ownership of EV stations), Luxury Cars (fractional ownership), and Fashion (NFT collections). **Pairpoint**, owned by Vodafone and Sumitomo corporation, and **Sensos**, founded by Sony Semiconductors have collaborated to combat supply chain fraud and automate payments. Through this collaboration, logistics companies can track their goods securely across the supply chain, using cellular tracking, AI, and digital identity, and automate payments upon delivery, using smart contracts.
- Digital Public Infrastructure (DPI) is emerging as a critical enabler for governments to foster open and inclusive development, delivering economic opportunities and services to all citizens. **India Stack** has revolutionized identity (Aadhar, Digilocker), payments (UPI), data (Account Aggregator Framework), enabling open networks for value creation and delivery.
- In-car payments and V2X have the potential to transform the automotive sector. Customers can now pay parking fee and fuel costs without getting out of their cars with several players like **BMW** in Germany and **Citroen** in India rolling out the services.

Impact

- The economy of things, powered by identity (for things) and tokens (for value), will enable peer-to-peer and machine-to-machine transactions, improving operational efficiency, reducing costs, and enhancing trust.
- Digitization (CBDCs) and tokenization (digital assets) will shape the future of regulated markets, enabling fractionalization of assets, improving liquidity and democratizing access to financial services.
- Decentralized technologies such as blockchain improves operational efficiency (by automating processes through smart contracts) while enhancing transparency and trust.
- This new economic paradigm, however, brings many trade-offs around performance versus scalability, technology adoption vs resilience, security vs privacy, transparency vs trust, and so on.

Tech

- **Technologies:** Ethereum, Hyperledger Fabric, Hyperledger Besu, Corda, Chainlink, Consensys Quorum, Solana, Cardano, Circle, Ripple, Contour Blockchain, Algorand
- **Digital Asset Custody and Wallets:** Ripple, Fireblocks, HexTrust, Settlemint, MetaMask, Tokeny, Anchorage, Komainu, Zodia Custody, Taxcryp, Copper, Qredo,
- **Securitization:** ConsenSysCodefi, Polymath, Securitize, Polygon, Progmat, Chainalysis, Certik, Magic, AnChain.AI, TaxBit, Secretarium
- **NFTs:** OpenSea, Rarible, Larva Labs CryptoPunks, Decentraland, Sandbox, Unity, Centrifuge, Dapper, Polarise, NFTfi, Forte, Magic Eden

Robert Engels
Expert in Residence

Thriving on Data

Where We Are

Like Foucault's Pendulum revealing deeper truths, data and AI unlock transformative results — driving innovation, efficiency, and resilience. They empower businesses to create smarter decisions, seamless operations, and personalized experiences. But to reach this state of data-induced euphoria, data and models must be treated as first-class products. They need to be easy to find, share, use and trust. And they have to be anchored where they're created and needed most to stabilize the business amidst constant change. While many organizations build data foundations like governance, quality and technology, the real challenge is activating data at the heart of strategy. It's about fostering trust and adoption across operations. Much like a pendulum aligning with Earth's rotation, businesses often swing between bold data initiatives and a truly data-powered culture, 'thriving on data' means mastering that steady, always changing rhythm.

Balancing Act

The realm of data and AI is all about finding balance, perpetually. Businesses are swinging between central data control and handing the reins to individual domains, aiming for agility without chaos. While generative AI hogged the spotlight, hybrid AI models — mixing tailored solutions with generative smarts — quietly show they're the next team players. Data must evolve from an untapped asset to a well-oiled action machine, fueling innovation, sharper decisions, and standout customer experiences. Sustainability, of course, plays a key part, keeping waste and resource needs in check without spoiling the passion. The real trick? Building data ecosystems that let businesses thrive with speed, purpose, with just enough order and care to keep it fun.

New Trends

The newly introduced trends in the **Thriving on Data** container show exciting, fresh approaches to the world of data and AI, while also being indicative of some of its conflicting forces and dynamics:

- **Data Sharing Is Caring (But Take Care!)**. Sharing data is a game-changer for innovation and collaboration, even among competitors. From internal platforms to real-time exchanges, data ecosystems are thriving. But don't overshare! In the age of generative AI, integrity, privacy, and compliance are non-negotiable. Treat data like a VIP product and share responsibly — because caring means taking care.
- **AI Meshed Up**. AI solutions are no one-size-fits-all affair. They're a dynamic mesh of multimodal, multi-model, and hybrid systems. These interconnected AI agents create adaptive feedback loops, driving efficiency and autonomy. But flexibility comes with challenges: transparency, ethical oversight, and calibration are critical. In this evolving AI mesh, progress is balanced by trust-building and continual fine-tuning.

3 Steps to Take

1. **Empower business-driven data ownership.** Shift from centralized control to federated management, putting data ownership in the hands of business domains. Ensure data is accessible, trustworthy, sensitive data protected while easy to use with open standards and automated platform services. This approach enables agility while maintaining coherence across the organization, turning data into actionable, high-value insights.
2. **Build hybrid AI solutions for real-world challenges.** Leverage a mix of generative and hybrid AI models tailored to specific business needs. Balance innovation with transparency and ethical oversight to maintain trust. By adopting diverse, purpose-built AI solutions, organizations can optimize operations, enhance customer experiences, and address challenges with flexibility and precision.
3. **Optimize data and AI for efficiency and sustainability.** Adopt frugal data and AI practices — choosing the right-sized datasets and models for the task at hand. Streamline processes to minimize energy use, CO_2 emissions, and waste while driving actionable insights. This dual focus on efficiency and sustainability ensures businesses can thrive responsibly in an increasingly data-intensive world.

Rajashree Das
Expert in Residence

Data Sharing is Caring (But Take Care!)

Collaborating in data ecosystems gets more value out of data, both internally and externally, as long as it's done with care

Collaborative data ecosystems are transforming the way organizations share, innovate, and thrive — even alongside competitors. Think of it as everyone bringing their best to the table: data that's secure, consumable, and shared in real-time. What works externally can also boost collaboration within. But with generative AI raising the stakes, there's no room for shortcuts. Data integrity, privacy, and authenticity are non-negotiable. Both providers and consumers of data products must take responsibility to avoid missteps and ensure compliance. The result? A smarter, faster, and more connected ecosystem — where everyone has a seat at the table. Can we get a Like for that?

What

- Collaborative data ecosystems, different organizations sharing data under applicable regulations to create new value for all participants, take many different forms relying on foundational capabilities such as privacy, ethics, ownership, trust, compliance, and accessibility.
- Federative approaches — data mesh — are emerging, pushing business domains to truly own and manage their data and its uses, to actively collaborate with internal and external partners. Treating data as a first-class product, not only providing trusted and fresh data but also making data products available to internal and external consumers through a compelling, self-service experience.
- Interoperability and open data protocols are required to allow systems to communicate and exchange information timely and securely.
- Organizations need to comply with the Data Privacy Act. Therefore it is important to have data sharing agreements with the organizations involved, and have the data privacy officer sign-off on certified and trusted data. They also need to make sure that certified LLMs are being used within enterprise.
- Data governance platforms and market places are enablers for data monetization, unlocking data value for competitive advantage, operational efficiency, customer experience, product enhancements, while taking care of potentially sensitive data, with anonymization.

Use

- **Researchers at Asan Medical Center** in South Korea have successfully applied homomorphic encryption (HE) to big data from multiple institutions, demonstrating its effectiveness in securely combining diverse data sources for predictive AI models while maintaining privacy.
- **The WISDOM Project**, comprising eight European universities, is using AI to address chronic immune-mediated diseases while integrating VEIL.AI's (a Finland-based startup) anonymization solutions to ensure compliance with GDPR and EHDS in handling sensitive health data.
- **The US Navy** collaborated with Anjuna Security, a US-based computer and network security company, and NVIDIA to deploy Llama3 LLM models on confidential NVIDIA H100 Tensor Core GPUs within the NVIDIA LaunchPad environment, using Anjuna Seaglass platform. It provided a virtualized, secure environment that was easy to deploy and operate.
- **Netflix** has partnered with clean room suppliers Snowflake, InfoSum, and LiveRamp to create data clean rooms that will allow advertisers to share data and build audiences in a secure and privacy-compliant way.

Impact

- Capgemini's past research has shown the benefits of data ecosystems for the private sector. These included a 15% improvement in customer satisfaction, 14% improvement in productivity/efficiency, and an 11% reduction in costs annually over 2–3 years.
- Collaborative data ecosystems are key to address societal challenges and organizational purposes, for example in health, public and citizen services, energy consumption, agriculture, and sustainability.
- In collaborative data ecosystems, organizations are likely to find unexpected new partners — fueling new, data-powered value streams, data monetization, and even breakthrough innovative business models.
- Embracing ownership and data-product management by business domains is vital to create an organization-wide, data-powered culture. Sensitive data can be anonymized through generation of synthetic data, which again can be fed into AI models as data-products.

Tech

- **Data Exchanges and Marketplaces:** AWS Data Exchange, Snowflake Data Marketplace, Dawex, Human Data Income (HUDI) Defi token-driven data monetization, Harbr Data Marketplace, Nokia Data Marketplace, Collibra Marketplace, Microsoft Azure Marketplace
- **Data-sharing Platforms:** Amazon Redshift Data Sharing, Microsoft Azure Data Share, Snowflake For Collaboration and Data Sharing, Databricks Delta Sharing, Google Analytics Hub, IBM Data Product Hub, eightwire, Immuta, baffle, bobsbled
- **Data-collaboration Platforms:** Harbr, Snowflake Data Cloud, Infosum Data Collaboration Platform, Duality Data Collaboration, Hex, LiveRamp, Walmart Luminate
- **Federated Learning:** IBM Federated Learning, TensorFlow Federated, Owkin Open Source FL, Microsoft FLUTE, Sherpa.ai, Nvidia Flare, FedML, Gemmo.ai, Flower, Duality, acuratio
- **Data Clean Rooms:** Snowflake Data Clean Rooms, InfoSum, LiveRamp, AWS Clean Rooms, AppsFlyer, Epsilon, Google BigQuery, Claravine, acxiom, Optable
- **Differential Privacy and Cryptography:** Microsoft Differential Privacy, Google BigQuery Differentail Privacy, Sarus Differential Privacy, Cosmian Confidential AI for the Cloud, Zama Fully Homomorphic Encryption, Cryptomathic
- **Data Collaboration/Data Mesh Enablers:** DataPlex, Cinchy, , IBM Data Fabric, Talend, Dremio, Snowflake, Omnisient, Starburst, Dataiku LLM Mesh, Splunk, Datastreams, Databricks

Padmashree Shagrithaya
Expert in Residence

Power to the People

A growing scarcity of specialized skills, the need to activate data as close to the business as possible, plus powerful AI and automation tools, are all driving the unstoppable self-service data revolution

Time to fight the central power! Within a true technology business, everyone can take the role of data scientist or data engineer. Data-powered operations may only be a chat away. It happens best when in close proximity to the business, at the very edges of central IT and data departments. It's part of a perpetual swing movement between central control and the decentralized edges, finding a balance point that fits the right moment in time. But the right skills are becoming more rare while secure, high-quality access to the right data is just as difficult to find. Generative AI and intelligent automation bring easy-to-use, self-service tools that provide the power of data to more people. They offload the pressure on central delivery, deal with scarcity, and democratize access and use of data. Something to push through the barricades for.

What

- Within a technology business, data needs to be accessed, used and activated. A Capgemini Research Institute publication shows that true data masters put a strong focus on data democratization.
- Extending data's reach empowers individuals, businesses, and communities — catalyzing informed decisions, sparking innovation, and driving societal progress while addressing historical inequalities in data accessibility.
- This alignment with data democratization is reflected in our customer-centric approach, which places people at the core. This means that it is centered around understanding and addressing customer data needs, preferences, and overall satisfaction. It includes personalization, data-driven customer experience, and customer performance analytics.
- Sustainability is another vital pillar. Projects like the sustainability data hub and net zero are of utmost importance now. We're leveraging renewable insights, optimizing intelligent IT operations, and building data trust as fundamental pillars to empower individuals and organizations.
- Global ethical AI leadership requires a balance between technological advancement and human values, ensuring technology serves the greater good.

Use

- **Stanford Medicine** and Microsoft deployed Nuance Dragon Ambient eXperience Copilot, providing conversational, ambient and generative AI to Stanford Medicine's clinicians to alleviate physician burnout and enhance patient care by streamlining administrative tasks.
- **Metro South Health**, an Australia-based Health Service provider, partnered with Salesforce to implement a low-code/no-code platform. It enhances internal apps development to complement its apps development team with capabilities to build out apps when needed.
- **Cineplex**, a Canada-based media and entertainment company, revolutionized its operations by enabling employees to utilize Microsoft Copilot Studio to develop customized, AI-driven copilots and Power Automate for scalable desktop flows, saving the company more than 30,000 hours annually.
- OpenAI and **Los Alamos National Laboratory**, a Mexico-based multidisciplinary research institution, partnered to evaluate how models like GPT-4o can assist with tasks in a physical laboratory setting through multimodal capabilities such as vision and voice.
- **The San Francisco Police Department** used Microsoft Power Platform to create an app that made the process of reporting stolen car returns near-instantaneous, ultimately saving hundreds of hours of driving time for the officers and also reducing department costs.

Impact

- Organizations can empower people with generative AI leading to improved workforce impact, reduced model creation costs — gaining a competitive edge, managing risks, promoting enterprise adoption. But for this they also need to ensure AI is trustworthy while protecting intellectual property. People can be prepared for a sustainable tomorrow by unveiling emerging climate tech data innovations, integrating climate technologies, and shaping the future of sustainable agriculture while recognizing the impacts on industries.
- Self-service of data, through data and model marketplaces can result in speedier availability of new insights to the business, improving responsiveness and adaptability.
- The AI supply chain can be automated with cost-effective, faster production of high-quality BI, analytics, and AI results, both near or within the business and from a central delivery function.

Tech

- **Data Marketplaces:** AWS, Snowflake, DAWEX, RAISE, Oracle Data Marketplace, Reply.io
- **Self-service BI and Analytics:** AWS QuickSight, Tableau, Qlik, SAS Visual Analytics, Dataiku, Saagie, Google, Google Analytics, Salesforce Einstein Analytics, SAP Analytics Cloud, Sisense, Alteryx, Microsoft Power Platform, Github Copilot, Amazon SageMaker, Spotfire, Microsoft Copilot, SAP Joule, Glean, Activeloop, Microsoft Power Platform
- **AutoML:** DataRobot, Google, H2O.ai, Microsoft, AutoKeras, Databricks, Feedzai, Kortical, Oracle, IBM, AWS, JADBio AutoML, BigML
- **MLOps:** Dataiku, Amazon SageMaker, Azure Machine Learning, Google AI Platform, MLflow, Kubeflow, Metaflow, Neptune.ai, Fiddler.ai, RAISE , H2O MLOps

Weiwei Feng
Expert in Residence

AI Meshed Up

A diverse mesh of different AI components, all with their own unique capabilities, provide better solution options while boosting the confidence level

AI solutions have outgrown their one-size-fits-all roots, evolving into a much more dynamic 'mesh' of multimodal, multi-model, and hybrid components. These interconnected AI agents work together, creating adaptive feedback loops that drive efficiency and autonomy, all focused on achieving specific objectives. But as the mesh becomes smarter, it also grows more complex: transparency, ethical oversight, and calibration are non-negotiable. Progress in the evolving AI mesh relies on an ongoing balancing act of trust-building and solution fine-tuning — because even the most intelligent systems need some help in keeping the threads from unraveling. We don't want a mess, after all.

What

- The AI mesh consists of a network of AI systems, humans, external systems, and data sources all interacting dynamically, forming a complex web of decision-making and information flow.
- AI nodes operate autonomously, processing data in real-time and making decisions independently or in collaboration with human inputs.
- Flexibility is key. Meshing your AI systems allows for a greater flexibility to alter, add and remove functionality from your ecosystem — functionality you defined yourself or adapted from partners, suppliers and the like.
- AI systems continuously analyze, learn, and adapt, creating non-linear knowledge flows that drive continuous system updates and refinements.
- Agents utilizing AI to (semi)automatically run processes for you — it almost looks like 'RPA on steroids.' Combining such agents in larger, multi-agent systems increase performance, flexibility and new ways of working emerge.

Use

- **Jurny**, a US-based property management provider, developed AI agents for concierge services, guest communications, and quality assurance to handle complex tasks efficiently.
- **NEC**, a Japan-based IT and network integration provider, created a multi-agent simulator to assess Scope 3 carbon emissions in supply chains, featuring agents, resources, and topology. The simulator can analyze 'what-if' scenarios to address both simple and complex inquiries.
- **Sysdig**, a US based real-time cloud security company, unveiled Sysdig Sage, the company's generative AI security analyst that uses an autonomous agent approach, leveraging multiple specialized AI agents working for simplifying and accelerating security for a faster, better-informed human response.
- **Workday** unveiled four new AI agents — Recruiter, Expenses, Succession, and Workday Optimize Agents that anticipate and streamline common business workflows to drive productivity and free users to do more strategic work.
- **T-Mobile** partnered with OpenAI to create AI agents for a customer service platform called IntentCX. This collaboration aims to enhance customer experiences using generative AI and already showing potential in analyzing customer care transcripts to identify areas for improvement.

Impact

- Companies embracing AI and meshing it up within their infrastructure can produce better products and services, tackling higher contextual complexity and find new products and services to deliver.
- The AI mesh accelerates data processing, decision-making, and system optimization, allowing the system to function with greater speed and scale.
- The mesh allows the system to continuously learn and adapt in real time, responding to new data and evolving to meet changing conditions.
- The intricate interactions within the AI mesh triggers the need to tackle a higher complexity that might be harder to predict, boosting development of new ways to monitor and utilize AI.
- Autonomous AI, run within the mesh, needs to have some governance and oversight in order to ensure ethical operations.

Tech

- **Developer:** Softwareagent.ai, Imbue, SWE-Agent, Composabl, Cognition, All Hands AI, Magic
- **Framework:** AutoGen, LlamaIndex, LangChain, AutoAgents, Adala, MemGPT, ChatDev, BabyAGI, Eidolon AI, Qwen, Swarm (Open AI), AgentVerse
- **Platform:** FlowiseAI, SuperAGI, Crew AI, Relevance AI, AutoGPT, Aisera, MultiOn
- **Governance:** Mosaic AI Agent, Langfuse, Agency AI, AgentOps.ai, Evidently. AI, Arize AI, watsonx.governance, Modulos, Fiddler AI
- **Ethical:** Impelsys – AI Agents, TensorFlow Responsible AI Toolkit

Barbara-Anne Bensted
Expert in Residence

Net Ø Data

Data is key to delivering net-zero ambitions. But data itself needs to be sustainable too. The battle against data waste is on

Zero is everything! All businesses need clarity on their CO_2 emissions and the impact of their sustainability actions. But you can't manage what you don't measure. To build and adjust net-zero strategies and overcome major sustainability challenges, businesses need to build skills, tools, and culture to measure, forecast, and act on, their emissions levels across the whole value chain. For companies, collaboration with their supply chain ecosystem is critical to access reliable data, especially scope 3, which lies outside the boundaries of an organization. But collecting, storing, accessing, and utilizing data comes with its own sustainability price too. It's a matter of being smarter about what data is needed, picking up the quest against data waste, and realizing that 'big' data is not always 'better' data.

What

- Data is a significant lever in accelerating the journey towards net zero. There must be increased visibility of baseline emissions and identification of emissions hotspots, improvement of existing business processes, and accurate prediction and prescription of business outcomes — all to drive net-zero objectives.
- According to a Capgemini Research Institute study, 45% of organizations with net-zero targets only use emissions data for mandatory reporting. Also, a majority of organizations remains oblivious to the environmental consequences of their data and AI strategies.
- The impact of data and AI on the climate is two-sided. The development and use of AI models, and their interaction with carbon-intensive applications, have potential negative impacts on the climate. The same applies to the growing heap of data waste that lies underneath.
- Energy is needed to create, store, move, and interpret all this data. 'Old' data easily becomes data graveyards, using lots of unnecessary energy and resources. The same pertains to the rapidly growing power needs of more and more complex AI models.
- Businesses must become smart about their data and AI models in use. This starts with categorizing and understanding their assets, its environmental impact, and ends with getting rid of redundant data and AI models, or deploying them in more sustainable ways.

Use

- **Georgia Tech** and Meta partnered for a project named OpenDAC to produce an open-source database to advance and implement direct AI solutions for carbon capture. This database has empowered the team to train an AI model that outperforms current chemistry simulations by several orders of magnitude in terms of speed.
- **Watches of Switzerland Group**, a luxury watch and jewellery retailer, is participating in a UK government funded pilot scheme led by Sevva AI, a UK-based company, to devise AI tools that will enable the Swiss group to track the ESG profile of its suppliers and retail brand partners.
- Google and **Environmental Defense Fund (EDF)**, a US-based non-profit organization, partnered to combine EDF's satellite – MethaneSAT data with Google's AI and infrastructure mapping to create a better understanding for how to mitigate methane emissions.
- **CO2 AI**, a Paris-based sustainability solution platform, and Quantis, a Swiss sustainability consultancy, partnered to drive substantial reductions in Scope 3 emissions across various industries globally by leveraging digital solutions to combat climate change.
- Google and **Danfoss**, a Danish multinational company, partnered to focus on AI and energy efficiency. Danfoss will use Google Cloud's gen AI to optimize and streamline its operations, and help Implement sustainable cooling for Google data centers.

Impact

- According to a Capgemini Research Institute report, 53% of organizations have experienced faster progress towards their net-zero goals when embedding emissions data in decision-making processes; on average, companies are seeing a 4.6% reduction in emissions as a direct result of emissions measurement and analytics.
- Innovating for process efficiency and product development is accelerated when organizations are equipped with the understanding of net-zero goals, skills, and tools to implement data-powered business decisions.
- Working in global cross-sector and industry-specific alliances with like-minded organizations is key to developing standardized emissions measurement methods. These approaches will help build more reliability into Scope 3 emissions measurement in the future.
- Building data management capabilities to manage emissions data will greatly strengthen a company's overall data mastery.

Tech

- **ESG Data Performance:** IBM Envizi ESG Suite, Microsoft Cloud for Sustainability, Google Carbon Footprint, Snowflake, SAP Sustainability Management, Salesforce Net Zero Cloud, MSCI, ISS ESG Index solutions, Electricity Maps, Ethos ESG, CSR Hub, SIX, S&P Global ESG, LSEG ESG Data, D&B ESG Intelligence, ESGDS
- **Carbon AI and Analytics:** AWS Customer Carbon Footprint Tool, Normative, IBM Environmental Intelligence Suite, Cloud Carbon Footprint, Google Carbon Sensesuite, SAP Product Carbon Footprint Analytics, Sievo, Microsoft Emissions Impact Dashboard, iQSpot, Klimametrix, Kayrros, CO2 AI, The Open Group Open Footprint Forum (OFF), MSCI Climate Investing, Net0, Carbon Analytics, CarbonRe, Carbon.ai, Emitwise

Gita Babaria
Expert in Residence

The Thing with Data

An abundance of data going around within the Internet of Things — at the edge — turns mundane objects into hyper-intelligent, connected assets near us

Here's the thing: in the vast ecosystem of technology, data is the lifeblood coursing through the veins of the Internet of Things (IoT) and edge computing. This isn't merely a jam of ones and zeros being pumped around; it's the rhythm powering industries and reshaping business landscapes. The IoT is transforming mundane equipment and products into data-powered, intelligent assets, weaving a web of efficiency across factories, supply chains, and our daily surroundings. This evolution isn't just about physical things becoming wiser though; it's about elevating businesses to unparalleled levels of innovation and connectivity. It's also about data and AI becoming intwined with our personal lives.

What

- Edge computing processes data locally, transforming everyday objects into intelligent, connected assets with real-time interaction capabilities.
- IoT, 5G, AI, and edge data centers all work together to create decentralized ecosystems for immediate insights, decision-making and actions.
- Local data processing eliminates the need for continuous centralization, reducing latency and enabling on-the-spot functionality.
- Compression and aggregation technologies optimize data handling, making edge systems faster, more efficient, and adaptable.
- This interconnected system bridges physical and digital realms, empowering seamless integration of technology into everyday operations.
- Global spending on edge computing was set to hit $232 billion in 2024, up 15.4%.

Use

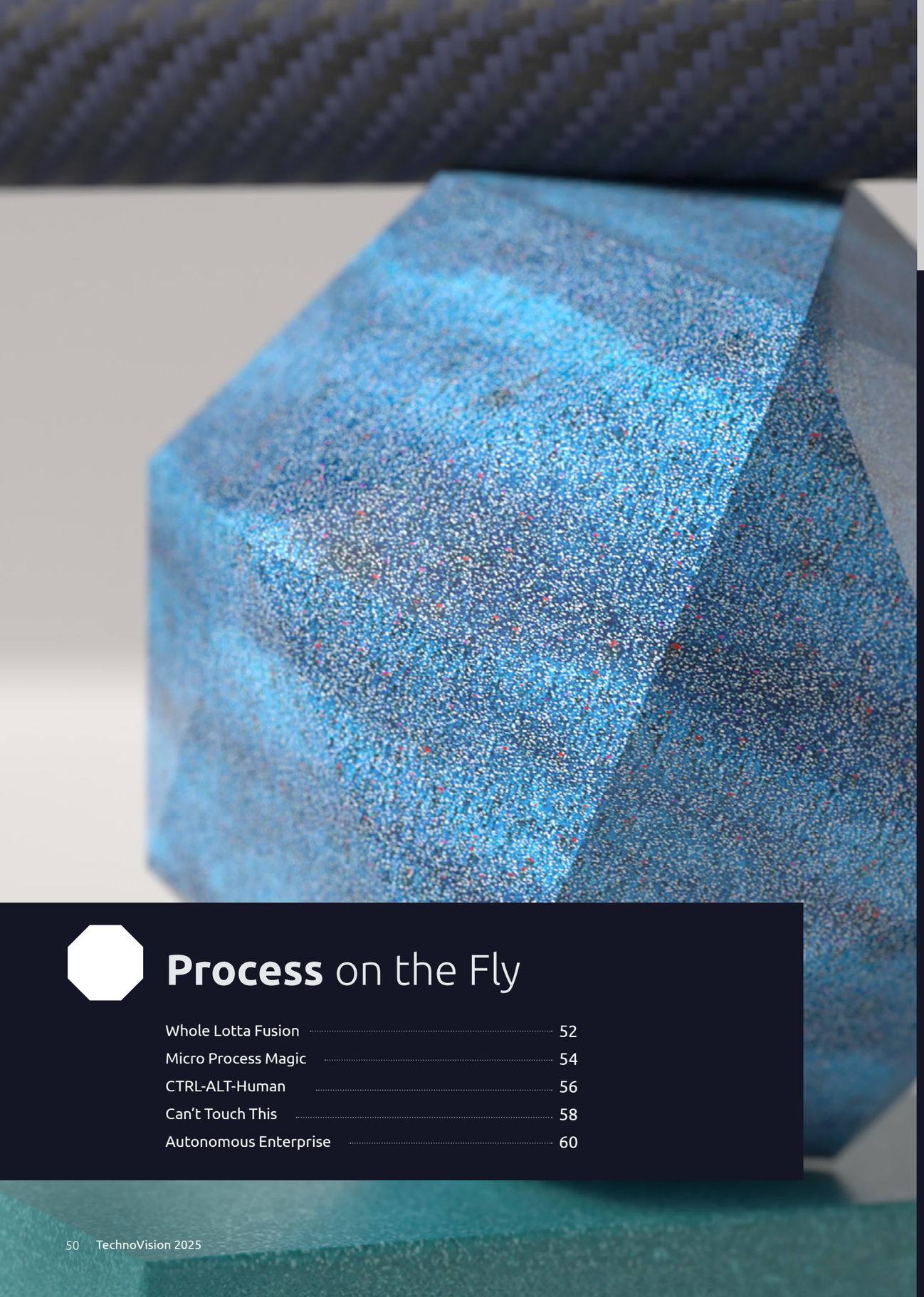
- **Johnson & Johnson MedTech** and Nvidia partnered for developing AI models that can be deployed on-site using edge computing. It results in a faster localized approach to deliver algorithms that can be employed in real-time surgical decision-making.
- **CERN**, the European Organization for Nuclear Research, introduced a new EU project called Edge SpAIce where it applies CERN's edge AI technology to detect marine plastic pollution in the oceans.
- **The US Army** chose wearable AI computers from Tomahawk Robotics to improve battlefield medicine. These devices are designed to help soldiers make quick, informed decisions and can document patient care without needing a network, running at the edge.
- **Northrop Grumman Corporation**, a US-based aerospace and defense company, showcased its Combat Edge software, enabling critical situational awareness data sharing on handheld devices without cloud connectivity. This technology enhances resilience and supports Joint All-Domain Command and Control for war fighters.
- **Sun Singapore**, provider of smart parking solutions, partnered with AMD to implement AI-based parking solution using AMD's PlanetSpark Edge AI Box X7, for efficiency and real-time AI inferencing at the edge.

Impact

- Edge-enhanced processing empowers businesses with real-time decision-making capabilities, setting the stage for innovative, instantaneous solutions.
- Smart compression and aggregation optimize bandwidth and reduce costs, paving the way for sustainable growth and innovative data strategies.
- Reinvented data dynamics transform passive data reservoirs into proactive assets, driving reliability and fostering novel business processes.
- Human-centric data design enables a future where data, close to the user, seamlessly covers user needs and experience, bridging the gap between technology and human-centric innovation.

Tech

- **Edge Platforms:**
  - **Hardware-focused:** NVIDIA IGX, NVIDIA Jetson, Qualcomm Edge AI Box, Intel Edge AI, Axelera AI, Google Coral (Tensor Processing Units), Hailo AI
  - **Software-focused:** IBM Edge Computing Platform, Azure IoT Edge, EdgeX Foundry, Siemens Industrial Edge, Gravio – The IoT & Edge Integration Platform, Edge Impulse, AWS IoT Greengrass, Google Cloud IoT Edge, Oracle Edge Computing
  - **Industry-specific:** Siemens Industrial Edge (Industrial Automation), Machinemetrics (Industrial Analytics), Telco Systems - Edgility (Telecommunications), Altair AI Edge (Engineering/Manufacturing)
  - **AI/ML-focused:** NVIDIA Deep Learning Accelerator (DLA), Intel Distribution of OpenVINO, EdgeVerve AI Next, NTT Edge AI, Microsoft Azure Machine Learning (AML) Edge
- **Edge-Embedded Services:** AI Edge Labs, Avassa, Codesys, ST Edge AI Suite, JSquared Commercial/Edge AI, Microsoft Azure Machine Learning (AML) Edge, AWS SageMaker Edge, Google Cloud AI Platform Edge, IBM Watson Edge
- **Edge-Embedded UX:** Ericsson D-15, Zurich Edge Platform
- **Edge Processors:** AiM Future, Hailo AI



Process on the Fly

Cara Antoine
Expert in Residence

Where We Are

Organizational aspirations remain pipe dreams without the ability to turn insight into action, adapt on the fly, and shatter those pesky silos. Enter technology-powered business processes: the movers and shakers behind agility and sustainability. In today's turbulent landscape, these processes demand real-time monitoring, tweaking, and even re-engineering to stay relevant. Over the past year, they've solidified their role as the operational backbone, tackling resource constraints and sustainability goals. With AI and intelligent automation setting the pace, augmented processes adjust in real time, anticipating actions and resources. Remote management reduces physical space, travel, and energy, paving the way toward a no-touch, net-zero, frictionless enterprise. Pretty fly, yes?

Balancing Act

The pendulum swing is more than apparent in the **Process on the Fly** container, where balancing acts define every move. Safety or speed? Control or flexibility? Human insight or machine autonomy? These oscillations shape every trend, forcing organizations to navigate dependencies with care. Striking the right balance, like embracing automation's speed while keeping human oversight in check, is the secret to adaptable yet controlled processes. It's a constant, dynamic exchange between extremes, where every swing carries the potential for innovation, or imbalance. Finding the harmony of the moment isn't just important, it's the difference between processes that thrive and those that falter under pressure.

New Trends

The newly introduced trends in the **Process on the Fly** container show exciting, fresh approaches to the realm of processes, while also being indicative of some of its conflicting forces and dynamics:

- **Whole Lotta Fusion.** When the physical world fuses with digital intelligence, it's a highway to overdrive. Digital twins, high-fidelity replicas of physical processes, let organizations simulate, monitor, and optimize without breaking a sweat. This fusion bridges virtual and real-world scenarios, enabling risk-free experimentation and electrifying operational visibility. The result? A whole lotta impact, delivered through sleek, digitally enhanced processes that truly rock.
- **Ctrl-Alt-Human.** Automation is stepping up, but it may be time to hit the reboot key and bring the human element back into focus. Ensuring people remain central to processes means blending intuition and oversight with machine efficiency. From critical decisions to ethical guidance, humans bring the adaptability and judgment needed to align automated outcomes and actions with corporate and societal priorities. Amid all the technological breakthroughs, the real reset might just be rediscovering the power of the human touch.

3 Steps to Take

1. **Implement real-time process analytics**. Adopt analytics tools that monitor and report on processes continuously, enabling quick interventions and fostering a proactive approach to management.
2. **Advance digital twins for core processes**. Create digital twins for key operational processes to experiment, predict outcomes, and make informed changes without disrupting live operations.
3. **Define human oversight in automation strategy**. Introduce clear protocols for human oversight within automated processes, ensuring that employees are equipped to engage effectively with AI, automation and even autonomous systems — making ethical and strategic calls as part of a truly 'hybrid' decision-making setup.

Anastasia Karatrantou
Expert in Residence

Whole Lotta Fusion

The fusion of physical and digital intelligence — powered by digital twins, robotics, and advanced connectivity — optimizes processes, enhances resilience, and drives scalable innovation

When the physical world fuses with digital intelligence, it's a highway to overdrive. Digital twins, high-fidelity replicas of physical processes, let organizations simulate, monitor, and optimize without breaking a sweat. Robotics adds another layer, automating tasks and collaborating with humans to enhance precision and efficiency. This fusion bridges virtual and real-world scenarios, enabling risk-free experimentation and electrifying operational visibility. The result? A whole lotta impact, delivered through sleek, digitally enhanced processes that truly rock.

What

- Digital twin is leveraged to design products and test their behavior and performance. They also design and stress test operations to evaluate their efficiency and ultimately design the E2E supply chain and optimize its resilience and ability to cope with environmental demands.
- Mixed reality applications can support the workforce in a variety of tasks and roles; onboarding engineers with AR-based training; enabling remote collaboration and connection with rare and remote expertise.
- Robotics, such as autonomous intelligent vehicles and autonomous mobile robots, are adopted to automate the distribution of goods. Simultaneously, cobots (collaborative robots) are being deployed to collaborate with humans when increased precision and repetition are required.
- IT best practices like software-defined and cloud-native architectures allow for hardware to become a commodity. The software on top of it provides a scalable and flexible value platform. This is mimicked in the operational technology space, as part of the accelerated convergence between the two domains.
- Hyperconnectivity and embedded sensors everywhere, allow for a fully connected, flexible and reconfigurable enterprise environment that can adopt advanced digital use-cases at scale.

Use

- **Foxconn** is leveraging NVIDIA Omniverse and Siemens Xcelerator portfolio, including Teamcenter, to create digital twins of its factories. This initiative aims to drive automation, enhance industrial efficiency, and reduce time, costs, and energy consumption. It also utilizes these virtual environments to simulate, test, and validate autonomous mobile robots (AMRs) and robot arms.
- **Benesch**, a US-based civil infrastructure firm, is using Bentley's iTwin Capture and iTwin Experience to create digital twins of project sites and develop AI/ML-powered workflows for automating and streamlining the process of detecting pavement cracks. The automated solution reduced the manual fieldwork by an estimated 75% over the course of three projects.
- **Volvo Group** and **Daimler Truck** formed a joint venture to develop a software-defined vehicle platform and a dedicated truck operating system. The platform will allow the decoupling of software and hardware development, enabling standalone digital vehicle functions. It will also allow wireless over-the-air updates to customers for enhanced experience and efficiency.
- **Jeh Aerospace**, an Indian startup specializing in precision aerospace manufacturing, is integrating GridRaster's spatial AI and AR/VR technologies to enhance training, inspection, and productivity in aerospace manufacturing.
- **Midea**, **Huawei**, **AIS**, and **China Unicom** jointly opened Southeast Asia's first fully 5G-connected factory. The factory, which primarily manufactures air conditioners, features a range of innovations, including AI inspection systems and real-time monitoring, automated guided vehicles (AGVs) with real-time 5G communication, and remote-controlled robotic arms, to boost efficiency, cut production errors, and enhance safety.

Impact

- Data-driven decisions with detailed performance insights create robust and resilient industrial processes. There's also smoother adaptation in case of unexpected change (e.g., supply chain disruption) and anticipation of planned change is optimized.
- Optimizing workforce allocation and leveraging rare expertise reduce onboarding time for complex industrial processes. This also accelerates the resolution of operational disruptions and increases workforce productivity, safety, and well-being.
- An AI-ready infrastructure that is future-proof and easily reconfigurable enables a fully connected enterprise, supporting advanced digital use cases that rely on premium quality of service without coverage gaps.
- A faster innovation cycle enables quicker introduction of services and products to the market with consistent and optimized quality.

Tech

- **Digital twin/Simulation:** Dassault Systemes, Siemens, Aveva, Ansys, Bentley, NVIDIA
- **Mixed Reality:** Apple, Microsoft, RealWear, XReal, Unity, Lenovo, GridRaster
- **Robotics:** ABB, Omron, Universal Robots, MiR
- **Edge Computing:** Siemens, IBM, AWS, Dell, Cisco, Project Margo
- **Industrial Automation:** Siemens, Rockwell, Schneider Electric, ABB, Beckhoff
- **IIoT:** Schneider Electric, Siemens, Emerson, Ubisense, Cisco
- **5G Networks:** Nokia, Ericsson, Siemens, Celona, HfR, Druid

Manuel Sevilla
Expert in Residence

Micro Process Magic

Miniaturizing processes into micro-sized forms to achieve greater speed, agility, and efficiency — while learning more about daily operations

It's a kind of magic. Imagine miniaturizing processes into smaller and smaller forms, using microservices, cloud technology, and the Web3 'mesh web'. These tiny, razor-focused micro-components enable rapid adaptation to market shifts and help reduce bottlenecks. They also optimize resource usage and minimize waste, while leveraging all goodness from advanced AI and automation. They not only drive cost savings and extreme agility but also keep businesses competitive in a dynamic market. Organizations need to integrate micro-processes into the corporate workflows to revolutionize operations with precision and adaptability. By escaping the confines of monolithic systems, the finesse of these independent units is harnessed to swiftly adapt and innovate, while rediscovering the essence of each and every process component involved. Enchanting!

What

- Every business process is triggered by an event or another process (has data in.. has data out) and may generate a transaction or call for a process. Yes! A process is like a service and can be organized and implemented with as many microservices as needed. This is the process magic and the native link between business processes and architecture.
- Microservice orchestration platforms enable the decoupling of services, fostering modular and scalable software architecture. It happens while streamlining development, accelerating product launches, and enhancing coordination and reliability in microservices-based applications through efficient management and automation.
- Low-code platforms accelerate app development with visual interfaces and seamless integration, supporting scalability, flexibility, and adaptability, and empowering developers to enhance and expand applications in response to evolving business needs.
- Web3 microservices can include the payment of the service itself without any need to add a complex invoicing process. It simpliflies the access to microservices in SaaS mode to a huge variety of providers, guaranteeing vendor independence and the ability to scale and adapt to country specificities.
- Service mesh solutions enhance miniaturization by providing codeless observability, improving reliability and security for cloud-native apps — offering efficient, out-of-the-box configurations for high request volumes.

Use

- **NVIDIA** introduced 25 new gen AI healthcare microservices to accelerate drug discovery, medical imaging, and digital health. Biotech, pharma companies and platforms, including Amgen, Astellas, DNA Nexus, Iambic Therapeutics, Recursion and Terray, and medical imaging software makers such as V7 are using these healthcare microservices.
- **Frasers Group**, a UK-based retail company, partnered with AND Digital, Valtech, and Lab Digital, to develop a digital platform using MACH architecture — Microservices, API-first, Cloud-native SaaS, and Headless — for streamlining operations such as inventory allocation, stock management and product tracking.
- **Workato** partnered with Creatio to combine Workato's AI-driven orchestration platform with Creatio's no-code CRM and workflow automation tools. This partnership connects Creatio with essential enterprise systems like ERP, HRIS, and ITSM, offering joint customers a comprehensive low-code/no-code solution for CRM and workflow orchestration.
- The **Sway** no-code AI platform integrated with Microsoft Azure, enabling users to build and deploy AI/ML applications directly on Azure. This integration simplifies AI development by allowing users to create, test, and deploy models without requiring deep data science or programming expertise. The collaboration streamlines workflows, reduces costs, and accelerates AI accessibility across industries.
- **Razorpay** launched DataSync, a no-code data integration platform that facilitates real-time integration of payment, transaction, refund, chargeback, and settlement data for businesses of all sizes. By automating data extraction and transformation processes, DataSync reduces operational costs up to 50% and improves financial reporting, fraud and security monitoring for businesses.

Impact

- Transforming a business process is already very difficult from the compliance, business, and human point of view. If it runs on top of a rigid IT solution, change becomes so difficult that it never happens. Using agile microservices makes the change possible.
- Microservices orchestration platforms automate container management, boost productivity, and support CI/ CD workflows. It also allows independent scalability, and enhance system resilience by isolating service failures, ensuring a robust and flexible software environment.
- Using microservices is an open door to finding the most efficient provider or solution targeting better cost, better scalability, quality, respect of new compliance rules, or better UI. By being able to easily improve each sub-part of the process, the whole process keeps improving continuously. Low-code platforms facilitate the development of streamlined, efficient, and nimble processes that can be rapidly created and deployed, often with minimized coding, resulting in cost savings and increased productivity.
- Reactive microservices enable miniaturization through efficient scalability, isolated failure impacts, improved developer productivity, resource efficiency, and reduced failure risks in application development and maintenance.

Tech

- **Microservices Orchestration Platform:** Temporal, Apache Airflow, Camunda, AosEdge, Orkes, dextcloud, SOAJS
- **Backend Development Platform:** Platformatic, StepZen (an IBM company), Encore
- **Low-code Platform:** Outsystems, Appian, Microsoft Powerapps, Zoho Creator
- **Reactive Microservices:** Lightbend, Micronaut
- **Microservices Infrastructure:** Kubernetes, Claudia.js, VMware Tanzu, communicating event streams such as AWS Kinesis, Google Cloud Dataflow, Confluent, Apache Spark, Kafka, AWS Lambda, KEDA
- **Service Mesh:** Kong, Tetrate Istio, Linkerd, Grey Matter
- **Serverless Computing/ Function-as-a Service:** AWS Lambda, Azure Functions, Google Cloud Functions
- **API Gateway and Management:** Kong, Amazon API Gateway, Apigee (Google Cloud)
- **Software Defined Networking:** Netmaker, VMware NSX, Azure Virtual network, Juniper Networks Contrail

Priya Ganesh
Expert in Residence

CTRL-ALT-Human

Automation amplifies human potential, blending human intuition with machine efficiency to drive ethical, creative, and innovative outcomes

Automation is stepping up, but it may be time to hit the reboot key and bring the human element back into focus. Ensuring people remain central to processes means blending intuition and oversight with machine efficiency. From critical decisions to ethical guidance, humans bring the adaptability and judgment needed to align automated outcomes and actions with corporate and societal priorities. AI is not just automating — it's amplifying human potential, taking on repetitive tasks while empowering people to focus on creativity and strategic innovation. Building robust collaborations between humans and machines ensures technology aligns with ethical values, fostering a future where human expertise and AI advancements reach new heights together. Amid all the technological breakthroughs, the real reset might just be rediscovering the power of the human touch.

What

- By strategically deploying AI to handle routine tasks, organizations can significantly enhance operational efficiency. This allows human workers to engage more deeply in problem-solving and innovation, propelling productivity and driving business growth.
- Leveraging AI for predictive analytics and automated forecasting transforms decision-making processes. By integrating real-time data analytics, organizations can anticipate market trends and customer needs with unprecedented accuracy, ensuring strategic agility.
- Combining AI with existing domain expertise bridges the gap between data-driven insights and experiential knowledge, ensuring a holistic approach to problem-solving. This integration not only preserves but enriches the organizational knowledge base, facilitating continuous learning and adaptation.
- By placing humans at the core of AI development and application, we ensure that technology complements rather than supplants human capabilities, leading to a more resilient and adaptive organizational model.

Use

- **Salesforce** has developed Einstein AI to power predictions, recommendations and chatbots within Salesforce CRM products. Keeping in mind the decision making based on AI, The Office of the Ethical and Humane use of Technology has been set up, guided by a set of core principles to ensure their AI promotes trust and maintains human oversight.
- At **Google**, clear AI principles, strong emphasis on creating socially beneficial, safe and accountable AI systems have been the core ideology. 'Pair' technology, which is part of Google's People + AI Research initiative, focuses on the human side of AI by studying and designing user interactions with AI systems to make them more user-friendly and accessible.
- **Anaplan** uses AI and machine learning within its connected planning platform to offer detailed and adaptive financial forecasting. The AI tools analyze historical data and current market conditions to forecast future financial scenarios.
- As **Walmart** is advancing its use of generative AI to enhance customer care, operations, and productivity, it is closely monitoring potential AI hallucinations, with human presence in the loop, to ensure accuracy and protect both customers and the brand. It is about focusing employee efforts around high-value tasks and reserving their input for critical oversight.
- **Verizon's** AI strategy implements Human-in-the-Loop (HITL) oversight to ensure responsible AI deployment in operations such as customer care. It feeds around 70 billion data points off the network every single day into AI engines to generate insights. It also constantly enhances tools available for customer care teams to remove the cognitive load off them.

Impact

- Advanced natural language processing has been instrumental in analyzing and interpreting commercial loan agreements. Automation of the labor-intensive process has reduced the cost and effort of manual reviews allowing employees to focus on higher-value activities and decision-making, leveraging the human insight where it is most needed.
- AI-driven chatbots have taken over routine customer inquiries and transactions. Human agents are now free to handle complex customer issues providing a personalized service. Additionally, AI helps in understanding customer behavior and preferences, which in turn allows human advisors to offer tailored financial advice and products.
- Enterprise performance is enhanced via real-time 'what if' scenarios, for example, creating a budget aligned to the actuals to avoid variance analysis and focus on planning for market conditions.
- Integrated AI allows for human focus on scenario building, market understanding and business advisory. Adaptive insights and automation of budgeting process enables analysts to generate financial forecasts that adapt to changes in the business environment.
- For the new era of Human and AI collaboration, the initial upskilling of resources and creating more domain expertise-led persona is important to enable the right AI build.

Tech

- **Autonomous/Super Agents:** Microsoft, Google, AWS, Salesforce, SAP, Anaplan
- **Large Language Models (LLMs):** OpenAI, Google, Meta
- **Process Automation:** UiPath, Automation Anywhere, Blue Prism, SAP, IBM
- **Autonomous Control Systems:** Honeywell

Lee Beardmore
Expert in Residence

Can’t Touch This

A process seamlessly adapting to its environment, delivering optimal performance — all without human intervention on the spot, all remotely managed

When all you have is a hammer, everything looks like a nail. Optimizing processes by cutting out yet another inefficiency, and leveraging yet another lean opportunity, only brings you so far. There is a limit to how classical processes can respond to complex events in real-time and in varying locations, while also serving sustainability. Driven by AI and automation, human- dependent processes can shift to powerful reasoning and acting systems, monitored, and managed from a distance. These systems adjust fluidly to whatever situation occurs, however remote the operation is, anticipating the next-best actions and resources needed on the fly. And while learning from what works, processes increasingly become hands- and care-free.

Stop! Hammer Time: touchless, remote processes are here.

What

- Business Rules Management System (BRMS) solutions externalize decision logic from applications, allowing both IT and business experts to define and manage decision logic. This logic can then be executed by Business Rule Engine (BRE) systems.
- Dynamic case management systems capture and process business events across process silos, providing end-to-end intelligence and optimized outcomes on a case-by-case basis.
- Any process can be mirrored and monitored through a digital twin, even when this pertains to the ‘classic’ enterprise (ERP) management processes, such as supply chain, finance and administration, and human resources.
- Provided with enough time series data points, analytics and AI can increasingly enable descriptive, predictive, prescriptive, and self-learning autonomous capabilities — usually in this specific sequence.
- Combined with intelligent process automation capabilities (as a combination of process automation and AI’s cognitive power), these insights can be turned into immediate, ‘touchless’ actions within business operations.

Use

- **Hitachi** deployed Celonis’ Process Intelligence platform to create a digital twin of its supply chain processes, gaining deep insights and enabling data-driven decision-making and targeted automation. As a result, it achieved $1 million in annual savings through purchase-to-pay automations and saved thousands of hours across supply chain processes.
- **OSTech**, a Japan-based outsourcing technology company, deployed Appian's Process Automation Platform as a business standardization system to enhance its business efficiency through end-to-end visualization, integration, and automation of business processes across systems. Following a successful trial implementation of the Appian platform, OSTech was able to reduce its workload by 25%.
- **Zoom** and ServiceNow partnered to integrate their gen AI technologies — ServiceNow Now Assist and Zoom AI Companion. This integration will automate workflows by transforming discussions from Zoom meetings into actionable tasks within ServiceNow, streamlining project management and reducing the burden of administrative tasks for employees.
- **IBM** and Shuto Technology collaborated to help a major joint-venture automotive OEM in China optimize its equipment maintenance using the AI-powered IBM Maximo Application Suite (MAS). The Intelligent asset management solution enhanced equipment repair efficiency with features like intelligent knowledge graphs, AI-driven fault diagnosis, and AR-based remote assistance, enabling faster problem-solving and reducing the mean time to repair (MTTR) by 25%.
- **Automation Anywhere** partnered with Google Cloud to integrate Gemini models and Vertex AI into its automation platform, enabling multimodal use cases such as automating loan underwriting, improving hospital patient communications, anti-money laundering (AML) compliance etc.

Impact

- Split-second responses to high-volume data streams and events in real time, particularly regarding the IoT and online customer channels.
- Providing superior, efficient, and seamless end-to-end customer and employee experiences that improve satisfaction and loyalty of both parties.
- Dealing with the scarcity of skilled and qualified human resources, not only by simply automating replicable tasks, but also by radically reimagining processes as touchless and handsfree by design.
- Eliminating the need for any human presence in business operations, improving personal safety, but also saving office space and travel — and consequently reducing energy consumption and CO_2 emissions.

Tech

- **Business Rules and Decision Management:** Secondmind.ai, Drools Open Source, Oracle Policy Automation, Pega Customer Decision Hub, DecisionRules, FICO® PlatformSource, Oracle Policy Automation
- **Complex Event Processing:** Amazon Kinesis, SAP Complex Event Processing, Tibco Business Events, Apache Flink, Esper, Confluent, Axiom, Informatica RulePoint, Red Panda, Timeplus
- **Process Mining and Twins:** Celonis, UIPath, QPR ProcessAnalyzer, iGrafix, SAP Signavio
- **Process Alow and Automation:** UIPath, Aera Technology, Appian, Anvyl, Workato, AirSlate

Alex Bulat
Expert in Residence

Autonomous Enterprise

Harnessing AI, the autonomous and unattended 'lights out' enterprise continually optimizes itself, bringing harmony and blending capabilities

'Agentification' brings a powerful new leap towards autonomous, self-driving businesses. Incorporating AI into the equation elevates mechanistic automation by not only enabling mimicry, but augmenting human intelligence with additional agentic players. This Human/AI agents combo not only jazzes up how we work but also fully reshapes our work processes and organizational structures, fundamentally altering the landscape of business operations and daily life. As AI continually optimizes the autonomous and unattended 'lights out' enterprise, it fosters harmony by blending the capabilities of humans and technology, creating a new level of synergy that drives innovation and a refreshed corporate purpose. Hitting all the right notes!

What

- Autonomous business operations are powered by self-providing, self-managing, self-optimizing, and collaborative systems. These systems prioritize goal attainment, predictive actions, and liberate decision-makers from labor-intensive tasks. It also contributes to agile product introduction, rapid capacity scaling, intelligent mass production, and environmental sustainability.
- AI agents enable a collaborative, yet advanced automation and mechanization of repetitive and physically strenuous tasks, like machine tending, enabling factories to function with minimal human involvement.
- Additive manufacturing or 3D printing enables 'lights out' manufacturing through unattended, autonomous operations, complex customization, production of intricate and complex designs with high precision, and a fully digital workflow.
- Automated production intelligence and processes utilize technologies such as AI, machine learning, and real-time data collection and analytics to achieve autonomous, predictive, and data-driven control over the manufacturing process and maintenance requirements.
- Super-agents, the next era of human and machine collaboration, orchestrates a symphony of AI processes in an ecosystem of autonomous operations, across physical and digital silos — masterfully collaborating with humans and machines ensuring a smooth back and forward motion.

Use

- **Microsoft** is advancing its agentic AI strategy by introducing a range of autonomous agents designed to enhance organizational workflows and customer experiences. It unveiled ten pre-built agents in Dynamics 365 to enhance various functions like sales, service, finance, and supply chain. Notable agents include the Sales Qualification Agent and Customer Intent Agent, which collaborate to automate tasks.
- **Salesforce** introduced Agentforce, an autonomous AI platform designed to transform business operations by deploying autonomous agents alongside employees across sales, service, and marketing. Unlike traditional copilots or chatbots, these agents retrieve data, handle complex tasks, and make independent decisions, allowing businesses to scale efficiently while maintaining strong customer engagement.
- **SAP** announced the integration of autonomous AI agents with its AI copilot Joule, aiming to support 80% of its most-used business tasks. These autonomous agents, each expert in a particular function, will collaborate to automate complex workflows, starting with use cases in finance for dispute management and financial accounting.
- **Honeywell** partnered with Google Cloud to enhance autonomous operations in the industrial sector using AI agents. The partnership will focus on 'purpose-built industrial AI agents' tailored to automate tasks, reduce design cycles, and assist technicians with real-time maintenance inquiries using multimodal data processing.
- **Unilever**'s site in Haryana, India has been recognized as a World Economic Forum (WEF) Lighthouse factory, exemplifying advanced digital manufacturing. Powered by AI and Automated Guided Vehicles (AGV) it operates with minimal human intervention through lights-out automation to enhance efficiency, lower costs, and significantly reduce emissions.

Impact

- Advanced robotics and automation enhance efficiency, improve productivity, reduce production costs over time, and significantly decrease the risk of worker injury.
- Additive manufacturing or 3D printing transforms business models by optimizing material use, reducing production times, fostering innovation, and enhancing product quality while cutting production, logistics, and inventory costs and speeding up time-to-market.
- Automated production intelligence contributes to heightened productivity, cost efficiency, and enhanced product quality, offering potential advantages such as reduced costs, elimination of human errors, and the ability to produce intricate, precise designs.
- AI-infused processes are unlocking novel possibilities, delivering unprecedented speed, and paving the way for the emergence of autonomous digital-only enterprises that can interact with humans independently, gradually approaching the era of autonomous enterprise.
- Eventually, superagents will be the only thing we need, boosting productivity, breaking silos and reshaping organization and thereby ushering in a new era of human-AI collaboration.

Tech

- **Autonomous/Superagents:** Salesforce, SAP, Microsoft, Talkdesk, Semantic Kernel, Moveworks, Ema, Leena.ai
- **Advanced Robotics/Automation:** Universal Robots, Fanuc, Flexxbotics, Covariant, GrayMatter Robotics
- **Additive Manufacturing:** Athena 3D, Additive Manufacturing Technologies (AMT), AXTRA3D, Bigrep One, Dyndrite, Carbon
- **Automated Production Intelligence/Processes:** Datanomix, MachineMetrics, Scytec, Vollmer, Tulip, BrainCube
- **Platforms:** SecondMind, Aera, Microsoft, DataRobot, Alteryx, 4Paradigm, H2O.ai, Boost.ai, RapidMiner, SenseTime
- **Artificial Solutions:** Teneo, WorkFusion, Amelia.ai, Ambit.ai, Cognigy
- **Loop AI:** Loop Q, Machinify, IBM Watson, Pega, Anaconda, Abacus.ai, Appian, Phaidra.ai
- **Adaptive Learning:** Celonis, Abbyy Timeline, Tecnotree, Beyond.ai, C3.ai

Thilo Hermann
Expert in Residence

Applications Unleashed

Where We Are

After riding the generative AI hype train, it's time to put the spotlight back on applications — the workhorses of enterprise innovation. Agile, lightweight apps are taking center stage alongside the next wave of modernized enterprise software, both custom-built and packaged. But the canvas is shifting. Today's applications might not just live in the cloud; they could reside on edge devices, or even within robots. Of course, generative AI hasn't left the stage — it's now a must-have in every software engineer's toolkit, boosting productivity and adding that 'AI cherry on top.' The challenge? Building smarter, greener, and resource-savvy applications ready to thrive in a tech landscape that's anything but static. Time to unleash the apps and break the mold.

Balancing Act

The world of applications contains an obvious balancing act between innovation and responsibility. Generative AI copilots may code and test at lightning speed, but mastering deep software engineering skills remains essential for building resilient, secure, trustworthy systems. While AI boosts productivity, it must complement human ingenuity, not replace it. AI-powered apps dazzle, yet their energy demands challenge sustainability goals. Robotic agents soon will expand the application canvas but must work alongside humans, not instead of them. The dream of 'one app to rule them all' raises privacy stakes, requiring a balance of convenience and security. The goal? Smarter, greener, human-centered applications, unleashed for a dynamic future.

New Trends

There is only one newly introduced trend in the **Applications Unleashed** container for 2025, as the current trends have stayed more than relevant. But this new trend surely highlights the conflicting forces and dynamics of the applications landscape:

- **App = A Robot**. What if your next application isn't just software — it's a robot? As robotics joins the application canvas, software engineers face thrilling new possibilities and equally intriguing challenges. From intelligent automation to physical interaction, apps are no longer confined to screens. But with great innovation comes complexity: coding for movement, decision-making, and real-world unpredictability. It's time to think beyond clicks and swipes because in this brave new world, your app might just walk, talk, or roll into action.

3 Steps to Take

1. **Make AI an integral part of applications**. Think AI at every stage, but don't lose sight of quality. Establish rigorous checks to avoid AI-generated errors or hallucinations. The pendulum swings between autonomous brilliance and human oversight, making it essential to strike the right balance for reliable, intelligent applications.
2. **Design applications with sustainability in mind**. Minimize resource use while maximizing AI's potential. Balance the benefits of larger, more powerful models with their environmental impact. The pendulum swings between innovation and responsibility, so prioritize frugal, efficient AI solutions that keep applications smarter and greener.
3. **Expand applications to embrace robotics**. Include robotics as part of your application strategy to unlock new opportunities. Flexible, adaptive systems can revolutionize business models but require careful control. The pendulum swings between groundbreaking innovation and operational risk. Build with foresight to keep your robotic applications in check.

Sarah Saunders
Expert in Residence

Honey, I Shrunk the Applications

Next-generation agile applications, built on the concepts of microservices, API-first, cloud-native, and headless (MACH), make up an applications portfolio that is cradled by AI and delivered via developer platforms

Applications used to be monoliths, cumbersome, bundled together with traditional user interfaces and hardcoded business logic. Well, we have big news: the science of application miniaturization is here — building application services that are tiny, stateless, efficient, and scalable. They are flexible, adaptive and responsive, morphing themselves seamlessly around new situations, needs, and use cases. The key ingredients of applications shrinkage are MACH. It's best combined with a miniaturization approach to the entire applications portfolio, firmly getting rid of old, inflexible, and costly legacy applications — making space for new ones. Then there is the power of AI, being an increasingly smart and productive buddy across the entire development lifecycle. Get your magnifying glass ready, huge things are happening.

What

- Apps are being set free from their platforms. Cognitive overload of the developers, trying to manage the complexity of building, testing, releasing and maintaining applications has been addressed by the introduction of the developer platform, supported by a team of customer-facing platform engineers. This frees the application developer to focus entirely on business-improving functionality, with the added bonus of creating an abstraction between the application and its deployment — allowing apps to fly free in the clouds!
- Time spent trialing various applications of generative AI and Machine Learning across the software development lifecycle, from initial thoughts of AI writing code or writing tests, has evolved into AI turning requirements into test suites and fine-tuning deployment parameters to ensure maximum runtime efficiency.
- Our code bases are often already too complex for one person to understand. We rely on long-running teams and documentation to support and extend applications. AI is now assisting in summarizing the dependencies and interfaces of application architectures, as well as helping to identify and patch security issues.
- Quiet apps are becoming greener by reducing data transfers, logging, and looping, while leveraging application metrics to identify and optimize the least efficient code. Using programming languages such as Haskell and Rust can significantly reduce an application's energy footprint.
- Few organizations master the art of systematic application rationalization. An end-to-end approach is needed to make room for new applications services, enabled by tools such as Capgemini's Clear Sight IT Decision Maker.

Use

- **Bharti Airtel**, an India-based telecommunication provider, deployed NetApp Astra Trident, which gave them a robust foundation to onboard their containerized apps, and it continues to support the delivery of persistent storage for their microservices backed by ONTAP.
- **Valmet**, a Finland-based automation systems and services, selected Capgemini to develop Valmet's reporting and analytics platforms, applications, and processes. Capgemini will assist Valmet in enhancing the agility and resilience of its IT-supported business operations by modernizing the integration platform for smoother information exchange. This will improve business continuity and simplify the application environment
- **Auto Club Group** selected Capgemini to migrate its core insurance processing applications to Google Cloud and simplify its IT infrastructure. The migration streamlines operations and enhances application capabilities and server management for improved efficiency, productivity. It's will also gain substantial long-term cost savings, around $500,000 per year, by consolidating its data centers and product suite to Google Cloud's infrastructure.
- **AlfredCamera**, a Taiwan-based global surveillance software company, modernized its application on AWS. The modernization doubled its speed of development while reducing management time by 80%, lowering costs by 20%, and scales in seconds.
- **Evo Banko**, a Spain-based digital bank, implemented Confluent Cloud for real-time fraud detection across 500,000 daily transactions. Using a microservices architecture, the bank accelerates feature deployment from months to days. It blocks 500 fraudulent transactions daily and has reduced weekly fraud losses by 99%.

Impact

- Faster, scalable, and intent-driven application services that are modular, sustainable, and fit for current and future technology business purposes.
- Faster time-to-market for new business services and products, as the enabling application services can be rapidly selected and integrated.
- Less need for massive, troublesome upgrades of entire application suites, as minimized application services are autonomous and only loosely coupled to others.
- Lower cost of software development and maintenance combined with higher software quality and reduced time-to-market.
- Faster development and change cycles due to the slimming down and reduction in complexity of the entire application portfolio.
- Better reuse and upcycling of application services, as they can be used, integrated, and interfaced in many ways, wrapping old legacy systems in peripheral microservices — allowing faster adoption, and saving scarce human resources and energy.
- Freedom to develop custom user interfaces shows that 76% of organizations have realized quantifiable benefits from their voice and chat initiatives in a variety of areas, from reducing customer service costs to increased NPS.

Tech

- **Re-platforming:** AWS Bluage, LzLabs Software Defined Mainframe, Capgemini Clear Sight IT Decision Maker, Capgemini Cloud Migration Factory, AWS Mainframe Modernization, Confluent
- **Agility:** SAFe, LESS (Large Scale Scrum), Scrum@Scale, Disciplined Agile
- **DevOps:** Headspin, OpenGitOps, Confluent Platform, Helm, GitLab, Azure DevOps Services, Capgemini DevOps accelerator - CREATE, GitHub Actions, Atlassian Bamboo
- **Microservices Infrastructure:** Kubernetes, VMware Tanzu, Kong, Cortex, communicating event streams such as AWS Kinesis, Google Cloud Dataflow, Confluent, Apache Spark, Kafka, AWS Lambda, KEDA
- **Voice Assistant Platforms:** Microsoft Cortana, Apple Siri, Amazon Alexa, Google Duplex and Assistant, Alibaba's AliGenie, Bixby, Hound, Databot, Voice Qube
- **Text Assistant Platforms:** WeChat Open Platform, Microsoft Bot Framework, Facebook Messenger Platform, Uipath Druid, Amazon Lex, Google Dialogflow CX, Salesforce Einstein Bots, Pega Chatbot, Aivo AgentBot

Ludovic Toinel
Expert in Residence

When Code Goes Know

Pair programming with an AI assistant boosts coding productivity and quality; it also accelerates learning curves — if you know what you're doing

Know what? Today, creating high-quality code is easier than ever thanks to API catalogs, pre-built templates, automation, and advanced low/no-code platforms. With generative AI, both professional developers and business users can now leverage language models that write code with the finesse of the best engineers. This technology enhances productivity and serves as an incredible learning tool — all through dialogue in natural, everyday language. It's exactly what an ambitious tech-driven business needs. However, an expert's oversight is crucial before releasing AI-generated applications. After all, AI is a co-pilot, not the pilot, as the saying goes: you know it when you see it.

What

- Platforms for citizen developers offer an intuitive way to create applications. Generative AI enhances these by enabling code generation, task automation, and logic improvement through natural language. Generative AI also supports complex workflows and suggests optimizations, making development faster and more efficient for all developers.
- Sharing best practices and building upon each other's ideas are vital components of success, as exemplified by the 'Maker Culture'.
- AI is becoming a powerful ally, helping create complex applications through Large Language Models trained on high-quality open-source code. This brings enhanced autocompletion, automated testing, and sophisticated reviews. However, a senior, experienced eye remains essential for validating results.

Use

- **Proximus**, a Belgium-based telecom provider selected Mendix low-code platform to develop their new flagship app, Proximus+. The app integrates six existing React Native applications into a cohesive native mobile user experience. This application serves as a centralized hub for millions of consumers, offering access to a diverse range of services across Proximus and its ecosystem of partners.
- **OutSystems** launched AI Agent Builder, an innovative solution integrated into the OutSystems Developer Cloud platform. It enables seamless integration of generative AI-powered applications into digital transformation strategies while ensuring governance to maintain standardization and security. With AI Agent Builder, IT teams gain access to all the necessary tools to construct generative AI agents and seamlessly embed them within both new and existing applications, without requiring any prior coding or AI expertise.
- **ServiceNow** introduced new no-code development and automation capabilities to accelerate digital transformation. The new Creator Studio, a part of ServiceNow App Engine, offers an intuitive, no-code environment empowering all employees to build applications. These enhancements complement ServiceNow's Now Assist for Creator generative AI capabilities, enabling business process owners to easily develop and implement automation ideas.
- **Salesforce** announced general availability of MuleSoft's Anypoint Code Builder, which uses trusted generative AI to help developers reduce costs and speed up software development cycles. Anypoint Code Builder is an integrated development environment (IDE) that allows developers to use natural language prompts to generate code, build APIs and integrations with contemporary tooling through Visual Studio Code.
- **Mistral**, a France-based AI startup, launched Codestral, a code-centric LLM with a 22B parameter, open-weight generative AI model that specializes in coding tasks, right from generation to completion. The model specializes in more than 80 programming languages, making it an ideal tool for software developers looking to design advanced AI applications.

Impact

- Increased application development productivity, on both sides of the business and IT spectrum, by choosing the best approach for the challenge at hand.
- Enhanced organizational agility through a significantly faster time-to-market for new business applications and a faster learning curve for junior software engineers.
- Higher code quality due to Large Language Model based on the knowledge of the huge open-source community.
- A cohesive alignment between IT and business functions through personally involved and committed 'citizen' application developers, using open, digital platforms.
- More innovative and higher-quality, business-facing applications that demonstrate enterprise robustness combined with agile solutions.
- Dealing with a scarcity of specialized software developers by enabling more people in the organization to quickly develop high-quality solutions without the need for deep skills and experience.

Tech

- **AI-based Tools:** ChatGPT, Replit Ghostwriter, Salesforce CodeGen, AlphaCode, GitHub Copilot, H20, Visual Blocks, MxNet, Amazon CodeWhisperer, Microsoft Cognitive Toolkit, Google Studio Bot, Harness AIDA, Code Llama, Llama 2, Claude 2
- **High-productivity Development Platforms:** Mendix, OutSystems, Microsoft PowerPlatform, Salesforce Lightning Platform, Betty Blocks, Appian, SAP Build Apps, Thinkwise, Pega, Usoft, UiPath Apps, ServiceNow App Engine, Zoho Creator's low-code platform, Retool, AgilePoint, AuraQuantic, Decisions, Lansa Professional Low-Code, Quixy, Airtable

Borja Tinao
Expert in Residence

App = A Robot

Robots are no longer just machines — they're programmable, intelligent agents, adding new dimensions and opportunities to the craft of software engineering

For software engineers, the canvas is shifting from screens to robots. These intelligent agents, equipped with cameras, LiDAR, and AI, don't just execute commands; they perceive, adapt, and collaborate in dynamic environments. Designing for robots means tackling new challenges: integrating real-time data from complex sensor arrays, building adaptive algorithms for unpredictable conditions, and ensuring seamless communication across networks. Advanced frameworks now allow coders to reprogram and customize robotic behavior on the fly. It's a new frontier where software engineers don't just build apps — they create intelligence that moves, senses, and innovates. Or to paraphrase, we're doing robotics harder, better, faster, stronger.

What

- The transition from rigid robotics to robotic agents represents a significant step forward in the field of robotics, enabling the development of more intelligent, adaptable, and collaborative systems.
- Robotic agents, equipped with an array of sensors such as cameras, LiDAR, infrared, and ultrasonic sensors, are capable of perceiving its environment, making decisions, and taking actions to achieve specific goals or tasks.
- Their designs often include various safety features, such as sensors, emergency stops, and protective barriers, to ensure safe operation and minimize the risk of accidents. Advanced software frameworks and programming interfaces enable the customization and reprogramming of robotic agents to meet changing requirements.
- Robots can possess varying levels of intelligence, from basic rule-based systems to sophisticated AI and machine learning algorithms empowering them to make decisions, adapt to dynamic conditions, and autonomously solve complex problems.
- By using Wi-Fi, Bluetooth, or specialized industrial standards for seamless data exchange and coordination, these robotics agents can communicate with each other, with human operators, or central control systems, enabling coordinated multi-agent collaboration.

Use

- **BMW**'s manufacturing division in the US has partnered with Figure, a humanoid robotics startup, to deploy a commercially viable humanoid robot. This deployment aims to test the feasibility of using humanoid robots in car production.
- **Tesla** has announced its plan to deploy humanoid robots to automate internal tasks, expected for internal use next year. Elon Musk, Tesla CEO, mentioned that 'Optimus', a Tesla robot, will soon be capable of performing factory-related tasks and is projected to be ready for sale by the end of 2025.
- **Dartmouth Hitchcock Medical Center**, a US-based healthcare provider, deployed the da Vinci 5 surgical robot for various procedures offering surgeons with a high-resolution 3D view of the surgical area and innovative force-sensing technology, enabling them to detect and measure the force applied to tissue during operations.
- **Chevron** has deployed Spot, a robotic dog from Boston Dynamics, for plant inspections in the US. Equipped with a camera, Spot records and logs observations in real time, helping workers make quicker, informed decisions. It can patrol the refinery, conduct equipment inspections, and alert teams to potential issues before they escalate — all without any wear and tear on the surroundings.
- **Transocean**, a US-based drilling company, deployed FANUC FoundryPro robots at its offshore drilling sites to handle extremely heavy work loads and create a safer work environment by removing employees from the dangerous red zone.

Impact

- AI-powered robots can adapt to changing environments, tasks, and conditions more effectively than traditional, rule-based robots, enabling them to manage a broader scope of applications and respond dynamically to evolving situations.
- They can learn from experience, continually refining and enhancing their performance, leading to greater efficiency and effectiveness over time.
- Using AI, these robotic agents can adapt their behavior and interactions to meet the preferences of individual users and operate with a higher degree of autonomy, reducing the need for constant human supervision and intervention.
- They can monitor their own performance and predict when maintenance or repairs will be needed, reducing downtime and maintenance costs.

Tech

- **Sensors:** Quanergy LiDAR, SICK Ultrasonic distance sensors, Sony Depthsensing Solutions, Garmin LIDAR-Lite v3, OMRON FQ2 vision sensor, Texas Instrument mmWave radar sensors
- **Actuators:** ABB Servo system, Mitsubishi servo motor
- **Communication and Networking:** Thales Secure Communications, Keysight Nemo Wireless Network Solutions, Intel Edge Computing, Qualcomm Robotics, NVIDIA Edge AI Solutions
- **Artificial Intelligence and Machine Learning:** NVIDIA Jetson, NVIDIA Deep learning, Tensorflow, Azure AI, AWS RoboMaker, IBM Watsonx.ai, Qualcomm Snapdragon, Unity ML Agents
- **Industrial Robotics:** Fanuc, ABB Robotics, Yaskawa Motoman, Universal Robots, Boston Dynamics' Stretch
- **Service Robotics:** SoftBank Pepper, Relay Delivery Robots, Aethon T3, Keenon Robotics, Blue Ocean Robotics UVD Robot
- **Medical and Surgical Robotics:** Intuitive Surgical's da Vinci, Mako by Stryker, Medtronic's Hugo RAS, Vicarious Surgical, Ekso Bionics, Saroa Surgical System
- **Cobots:** Universal Robots (UR) Cobots, Fanuc CRX Series, Yaskawa Motoman HC Series, KUKA LBR iiwa, ABB YuMi, Doosan Robotics M Series, Techman AI Cobot

Sjoukje Zaal
Expert in Residence

Little Green App

Applications engineered to be less demanding in terms of resources and energy with superior performance are more sustainable, but also are of higher quality

There is a mixed bag of 'green' software engineering approaches and tools, all focused on creating long-lasting software that uses less energy and resources while executing faster and more efficiently. Software does not consume energy or emit harmful biproducts on its own. The issue is with how software is developed for use — and then how it is used. Companies integrate software into their sustainability efforts by judging its performance on energy efficiency with a focus on security, scalability and accessibility. Some include green practices and targets as key criteria for CIO performance reviews. Sustainable software engineering principles have been developed to assess eco-friendliness and spread best practices. Because the IT sector is expected to account for 14% of the world's carbon footprint by 2040, green software engineering clearly matters.

What

- Building a green app is always a trade-off, and only experienced architects and developers can fulfil the requirements of the business as well as reduce the impact on the environment to a minimum.
- Promote continuous learning about green development practices and educate development teams about sustainable practices.
- Choose the best-fitting architecture for sustainability requirements. A focus on cloud-based solutions is often sensible and helps organizations measure and reach the sustainability targets they set.
- Microservices are not a silver bullet, so check for the benefits (scaling, best-fitting technology) versus the challenges (network traffic, data replication) — and decide accordingly.
- Invest in algorithms and choose the most efficient ones for the given business challenge but be aware that premature optimization is the 'root of all evil'. Only optimize what you really need to optimize.
- Frameworks and products will add a lot of abstraction and complexity, so choose the simplest ones that satisfy business requirements.
- The most efficient software is the application that doesn't exist. The KISS (Keep it simple, stupid) principle, holds true for green apps, and you should reduce the following dimensions: CPU, RAM, Disk, and Network.
- Don't forget about the lifecycle, as things will change over time and efficiency might also change. Keep an eye on your efficiency by establishing a mechanism for measurement (e.g., with a dashboard).

Use

- **Schneider Electric** launched a new automated sustainability reporting feature to its EcoStruxure IT data center infrastructure management (DCIM) software. The automated sustainability reporting enables operators to calculate and track the PUE per site and room over time. Using it, Schneider Electric was able to reduce its energy consumption at their smart factory in Lexington, Kentucky by 30% between H1 and H2 in 2023.
- **Suntory Beverage & Food Europe** deployed SpheraCloud corporate sustainability software to support their sustainability journey to net zero. The automated data collection, reporting tools, and extensive emission factor libraries will enable Suntory to meet regulatory requirements.
- **Alibaba Cloud** deployed its sustainability platform energy expert to help cut emissions in the production of Hangzhou Asian Games-licensed products and the daily operations of stores inside the Asian Games' villages. The AI-powered platform helped optimize the carbon footprint of the Hangzhou Asian Games' mascots through its prebuilt calculation model leveraging public emission factors, datasets and proprietary datasets.
- **FanDuel**, a US-based sports gaming company selected AWS as its strategic cloud provider and is comparing its carbon footprint to sustainability objectives using tools like the AWS Customer Carbon Footprint Tool. FanDuel is collaborating with AWS to lessen its environmental effect and improve the efficiency of its operations.
- **Oracle** announced Oracle Cloud EPM for Sustainability, a new solution in Oracle Fusion Cloud Enterprise Performance Management (EPM) that helps organizations efficiently measure and effectively manage sustainability initiatives. With purpose-built dashboards and automated analysis, organizations can monitor progress and take corrective action in a timely manner.

Impact

- Contributing to the corporate sustainability agenda by engineering applications for less energy consumption, fewer CO_2 emissions, and less environmental impact.
- Attracting scarce, skilled development resources as more people prefer to work on solutions in a sustainable, responsible way.
- Through the focus on efficiency, applications will not only be greener but also better performing — leading to higher satisfaction with users.
- Green applications are optimized for efficiency and use of resources. Therefore, run costs are lowered across the entire lifecycle.
- A thorough assessment, which focuses on simplifying and cleaning up application services, is beneficial for maintainability and overall quality of the software.

Tech

- **Development Tools:** Greensight, Capgemini's sustainability and efficiency plugin for SonarQube
- **Eco-friendly Apps:** Ecosia, Carbon Aware SDK, Cloud Carbon Footprint, Microsoft Emissions Impact Dashboard, CodeCarbon, JoularJX, INRIA PowerAPI, Cirrus Nexus TrueCarbon, Avarni, AWorld, Sustaira, ESG Playbook, ClimatePartner, GreenFrame, IBM Environmental Intelligence Suite, Schneider Electric EcoStruxure, Accuvio Sustainability Reporting Software, Climeworks, ENGIE Impact
- **Frameworks:** Principles of Green Software Engineering, Sustainable web design, AWS Blue/green deployments, The Green Software Toolkit (The Shift Project)

Khambampati Sailu
Expert in Residence

Chat is the New Super App

AI-augmented chatting and talking in plain, natural language becomes the new app to rule them all

It has been the ambition of quite a few captains of IT industry: creating one 'super app' that can be used to manage and launch whatever application service one could possibly need. But it would still be an app, with an interface that needs to be mastered and a logical flow that must be followed. What if all of that would simply disappear and be replaced by simple dialogue in natural language? The rapid breakthrough of AI-augmented chat systems, combined with an infinity of multi-modal, subject matter-specific plug-in models, is making this a reality. It will democratize access to applications, driven by a radically new design concept for software engineers.

Supercalifragilisticexpialidocious!

What

- A super app is an application (typically envisioned as a mobile app) that provides many different applications services through one integrated platform interface, eradicating the need for managing and launching multiple applications.
- Many industry players have aspired to provide and own such a super app, as it secures a central place in a diverse application services ecosystem.
- With the rapid evolution of chat-based, natural language interfaces (triggered by OpenAI's ChatGPT) a new, preferred user interface has emerged, possibly further strengthened by voice capabilities.
- With most of these chat systems having an open, plug-in extensions mechanism for application-and subject matter-specific contents and actions, it becomes interesting to provide application services through the chat system. This renders a chat system into an unexpected, but undeniable super app.

Use

- **Accor**, a Europe-based hospitality company, launched a new Travel Assistant which uses the ML and generative AI capabilities of AWS to learn from and pick up on guest preferences, allowing Accor to cater to the needs of multimodal guests, who combine business and leisure experiences into the same trip.
- **John Snow Labs**, a US-based healthcare AI company, deployed its new generative AI offering based on John Snow Labs' own healthcare GPT LLM and chat platform. John Snow Labs' medical chatbot has been designed to facilitate medical conversations, ensuring that healthcare professionals can engage in an interactive dialogue to extract precise information needed for clinical decisions or for building patient cohorts.
- **Smartsheet**, a US-based enterprise work management platform, implemented Amazon Q Business, a new generative AI-powered assistant, to streamline knowledge management and accelerate employee productivity in the cloud. Smartsheet integrated Amazon Q into its Slack app to provide over 3,300 global employees with instant answers without needing to locate information manually reducing the time employees spend searching for information.
- **GitLab** announced the general availability of GitLab Duo Chat, which brings the GitLab Duo suite of AI capabilities together into a single, easy-to-use, natural language chat interface to connect DevSecOps workflows across the entire software development lifecycle.
- **Vodafone** released SuperTOBi, its new customer-focused generative AI driven virtual assistant across Europe. SuperTOBi, powered by Microsoft Azure OpenAI, can understand and respond faster to complex customer enquiries better than traditional chatbots.

Impact

- Leveraging the superior dialogue qualities and consumer reach of chat front ends such as ChatGPT will lead to better connect to the market and serving customers in a better way.
- There won't be any need to work on, or manage or own proprietary application interfaces.
- Users can be the front runner in the integration of new services, either by themselves or with partners and an ecosystem.
- It can also be the motor for disruption on traditional businesses by combining different services to offer a much better and simpler user experience. It's empowering to have the first point of contact.
- Chat super apps can collect vast amounts of data on user behavior and preferences. It can be used to improve services, personalize user experiences, and provide valuable insights and data for business decisions and marketing.

Tech

- **AI-based Tools:** Replit Ghostwriter, IBM Watson Studio, H20, TensorFlow, MxNet, Microsoft Cognitive Toolkit, Harness AIDA, Vicarious AI, Einstein AI (Salesforce), Clarifai, C3 AI Platform, Altair RapidMiner, DataRobot
- **Super Apps:** Alipay, OMNi, Rappi, Grab, Troop Messenger, Gojek
- **AI-based Chatbots:** ChatGPT, Google Bard, HuggingChat, Zapier AI Chatbot, ChatSpot, OpenAI playground, Poe, DeepAI Chat, Claude, Zoho Zia, IBM Watson Assistant, Zendesk Chat, Replika, Chatfuel, HubSpot Chatbot, Cleverbot, SnatchBot, Ada CX
- **For Searching the Web:** Microsoft Bing AI, Perplexity, YouChat, KoalaChat
- **Content Writing:** Jasper Chat, Chat by Copy.ai, ChatSonic, ZenoChat, Writesonic, ContentBot, Rytr, Wordtune, Anyword, Grammarly, Quillbot, Neural Text, Scribe
- **For Coding:** GitHub Copilot, Amazon CodeWhisperer, Google Studio Bot, Salesforce CodeGen, DeepCode (by Snyk), Codeium, CodeGPT, Codex by OpenAI, Sourcegraph, IntelliCode (Visual Studio), Glitch, BuildAI

Invisible Infostructure

Dapo Adekola
Expert in Residence

Where We Are

The era of **Invisible Infostructure** is becoming real: a digital foundation that's both virtual and indispensable. Autonomous, self-learning, self-healing and powered by AI, it quietly enables the modern enterprise, connecting everything, including 'things' and edge devices. But don't let it subtlety fool you. With quantum and neuromorphic computing, and next-gen connectivity stretching to non-terrestrial networks, it's reshaping what infrastructure can do. As specialized high-performance computing evolves to meet AI's relentless demands, delivering leaps in capability, it's a backbone that must scale effortlessly while staying energy-conscious. This isn't just IT infrastructure — it's the force keeping businesses adaptive, innovative, and ready for whatever comes next. Quiet, yes. Invisible, maybe. Essential? Absolutely.

Balancing Act

Infrastructure certainly drives a perpetual balancing act, juggling competing forces. AI may dazzle with autonomy, but humans remain essential for judgment and control. Industry-focused solutions promise tailored precision, yet ubiquitous platforms bring unmatched scalability and versatility. Compute power races ahead, but sustainability pulls the reins on energy demands. Sovereign control ensures local compliance, while global networks foster cross-border collaboration. Ambient edge computing pushes intelligence closer to users, even as centralized systems ensure consistency and scale. Meanwhile, terrestrial networks vie with satellite communications for the future of connectivity. Each swing forces organizations to rethink priorities, chasing the harmony of the moment in an ever-shifting landscape.

New Trends

The newly introduced trends in the **Invisible Infostructure** container show exciting, fresh approaches to IT infrastructure, while also being indicative of some of its conflicting forces and dynamics:

- **Everything, Everywhere, All At Once Connected.** Connectivity has become the star of the digital age, transforming from a supporting act to the fabric uniting industries and technologies. With 5G, satellite networks, edge computing, and soon 6G, it's the infrastructure that indeed enables 'everything, everywhere, all at once' — not just a play on a movie title, but a hyper-connected reality. And equally award-winning.
- **Cloud Encounters Of the Third Kind**. As the cloud frontier expands, businesses are having their own close encounters with a whole new kind of IT. It's driven by industry clouds, specialized AI setups, and a galaxy of embedded tools. The new cloud isn't just about storage and compute; it's about sovereignty, sustainability, and an increasingly diverse mix of deployment options. With a focus on net-zero operations and dynamically optimized workloads, it not only enables a new operational reality but also reduces carbon footprints.

3 Steps to Take

1. **Leverage AI for autonomous operations**. Implement AI to drive self-learning and self-healing capabilities across your infrastructure, from architecture to operations. Ensure these autonomous systems enhance optimization and resilience across all environments — whether in the cloud, on-premises, or at the edge.
2. **Build seamless interconnectivity everywhere**. Prioritize rapid, cost-effective data transfer across corporate domains, factories, storefronts, and remote locations. Leverage emerging terrestrial and non-terrestrial connectivity solutions to ensure seamless access to insights and decision-making in an increasingly interconnected world.
3. **Embrace the compute evolution responsibly**. Capitalize on advancements in neuromorphic, quantum, and AI-driven high-performance computing to stay ahead. Address post-quantum threats with robust defenses while balancing sustainability impacts with strategic goals, ensuring compute power delivers value without compromising long-term responsibility.

Daniel Koopman
Expert in Residence

Cloud Encounters of the Third Kind

With the cloud evolving and maturing, it's time to create a new, smart mix of sovereignty, sustainability, agility, deployment options and specialized capabilities

As the cloud frontier expands, businesses are having their own close encounters with a whole new kind of IT. It's driven by industry clouds, specialized AI setups, and a galaxy of embedded tools. The new cloud isn't just about storage and compute; it's about sovereignty, sustainability, and an increasingly diverse mix of deployment options. With a focus on net-zero operations and dynamically optimized workloads, this wave not only enhances operational efficiency but also reduces carbon footprints. The new kind of cloud brings speed, agility, and laser-focused compliance. It's time to answer the call, adapt smart, and make your own cloud encounter a transformational journey, not just an alien blip.

What

- Cloud is dominating IT budgets, with top talent seeking out work that provides access to cutting-edge technology within high value-creating teams. Traditional IT's desire to maintain legacy systems with legacy processes is a drag on service delivery speed.
- Developers expect environments that leverage AI-assisted coding, tight cloud API integration, and guardrails with organizational standards embedded.
- Industry cloud ecosystems are emerging, driven by sector-specific regulations, and market demands need to combine tailored processes, AI integration, compliant infrastructure, and specialized analytics to accelerate innovation while meeting unique industry requirements.
- Organizations, from retail to defense, offer sovereign and secure cloud solutions to address concerns over data privacy, regulatory compliance, and digital sovereignty.
- AI-focused data centers leverage cloud-based high-performance computing, and sustainable power solutions like nuclear or solar farms have democratized HPC resources across industries, sizes, and geographies. Organizations clinging to legacy processes and failing to leverage these advancements risk obsolescence.

Use

- The **Salk Institute** reduced computing costs by 20% and enhanced stability with its Google Cloud SkyPilot program, mapping the entire mouse brain at the molecular level for the first time. SkyPilot achieved 5.7x cost savings through managed cloud functionality.
- **GE HealthCare** uses AWS's healthcare and generative AI services to build and implement new, versatile foundation models, generative AI applications and to accelerate software development.
- **ClearBank**, a UK-based bank, moved its services to Microsoft Azure Service Fabric and App Service Environment, pushing 183% more monthly system releases. It has a robust, reliable platform to support the latest banking products and services for financial institutions.
- **Nebul**, a European Sovereign AI Cloud platform, helps companies across the EU unify their data, deploy NVIDIA-powered Private AI solutions, and derive actionable insights through a secure, sovereign, robust cloud infrastructure.
- **Atommap**, a computational drug discovery company, built an elastic supercomputing cluster on the Google Cloud to empower large-scale, computation-driven drug discovery. Atommap's platform has dramatically reduced the time (by more than half) and cost (by 80%) of molecular discovery.
- **Pfizer**'s Future of Development program addressed 30x developer growth by investments in modern cloud tooling, tailored training and certification courses. Pfizer saw a 33% decrease in developer attrition risk and increased code quality.

Impact

- Leveraging platforms that provision foundational cloud infrastructure and developer tooling, with observability and security tightly integrated, can accelerate cloud adoption and modernization and are expected 'table stakes' for high-performing teams.
- Industry cloud solutions that automate compliance, sales, marketing, customer service, financial management, and align the supply chain to customer demand, will drive human interactions to where they deliver the most significant impact.
- Innovation, through research and engineering, is unlocked by ready access to globally distributed AI/ML capabilities incorporated into the latest HPC cloud environments.
- Cloud providers will accelerate organizations reaching their sustainability targets by leveraging net-zero plants and dynamically distributing compute workloads to the optimum location for cost and sustainability.

Tech

- **Platforms:** Fly.io, platform.sh, Accelario, Vercel, IBM OpenShift, Koyeb, Cloudflare, Salesforce, Veeva, RunPod, CoreWeave, Rafay, Rescale, Paperspace by Digital Ocean, Vast.ai, Cirrascale, Weights & Biases, Fermyon
- **Data Platforms:** starburst.io, Snowflake, Dataiku, CockroachLabs, Databrick, Rigetti Computing, D-Wave
- **Observability:** Cisco-AppDynamics, chronosphere.io, Coralogix, Dynatrace, Datadog, Grafana Labs, Sentry, honeycomb
- **Sustainability Tools:** Microsoft Emissions Impact Dashboard, Google Carbon Sense suite, AWS Sustainability Tools, Google Environment APIs
- **Hybrid, Multi-cloud Tools:** Google Anthos, Azure Arc, Backstage, Crossplane, Port
- **Sovereign Cloud:** GAIA-X, T-Systems, Oracle, OVH Cloud, StackIt, Nebul
- **Cost Management ('FinOps'):** Azure Cost Management, AWS Cost Explorer, Kubecost, Apptio, Spot.io, firefly.ai
- **Developer:** GitPod, Github Codespaces, Replicated, humanitec, teleport, Pulumi, solo.io, temporal
- **Cloud Infrastructures for LLMs:** Lambda Labs, Paperspace by Digital Ocean, NVIDIA DGX, Jarvis Labs, CoreWeave, Vast AI, Latitude.sh, Seeweb, FluidStack, Skyflow, Deepset
- **Connectivity Cloud:** Cloudflare, Skycloud, Ray.io, Skypilot, Spectro Cloud

Shamik Mishra
Expert in Residence

Everything, Everywhere, All At Once Connected

Connectivity has become the foundation of a hyper-connected world, seamlessly linking devices, industries, and ecosystems to drive unprecedented innovation

Connectivity has officially stolen the spotlight, transforming from a supporting act into the leading role of the digital age. With 5G, satellite communication, edge computing, and the promise of 6G on the horizon, it's not just the enabler of everything, everywhere, all at once, it's the infrastructure making hyper-connected ecosystems a blockbuster reality. As decentralized networks rise, modern connectivity stretches from handheld devices to industrial machines and vehicles, forming a seamless web that binds everything to high-performance data centers. High-speed networking technologies like Infiniband and NVLink are stepping up, freeing systems from the limits of compute capabilities with network-powered cluster computing. Think of it as connectivity's own multiversal moment: breaking the rules of traditional infrastructure, reducing latency to near-zero, and scaling to handle the data overload. Move over, movie magic — this is connectivity's Oscar-winning performance, and it's playing in a theater near you.

What

- The expansion of mobile networks, has made high-speed internet access widely available. The emergence of satellite communication combined with terrestrial networks extends this digital fabric to cover remote areas, enterprises, and businesses. Covergence of terrestrial networks (TN) and non-terrestrial networks (NTN) is critical for developing a globally connected digital fabric.
- Internet of everything is driving wireless connectivity into everyday objects, enable automation, remote monitoring, and smart functionalities building a connected world. Connectivity is vital for critical services such as healthcare and emergency response making them accessible anywhere, anytime.
- Smart cities need connectivity to manage resources, transportation, energy, and public services efficiently, while adapting to the needs of their populations in real-time. 5G wireless connectivity along with distributed compute at the edge power the transformation.
- Applications depend on data to personalize services and enhance experience. The data needed for such solutions require high-speed and reliable connections. This has led to the convergence of AI, digital infrastructure and connectivity to enable business and people to run better.
- As AI becomes mainstream, the performance efficiency vs cost of compute curve is flattening. Therefor high-performance compute needs to be re-developed using advanced and high-speed low-latency networking. New technologies and standards are required to scale with stability and reliability. Initiatives like UltraEthernet, RDMA over converged ethernet and Infiniband, are revisiting these transport and ethernet protocols.

Use

- **Starlink** launched direct-to-cell satellites into space. Today the services are designed to connect to unmodified handsets but in future high-speed internet access like 4G/5G experience is expected to be available for handsets.
- **Vodafone** and **Vodacom** plan to use Project Kuiper, Amazon's low Earth orbit satellite (LEO) communications initiatives with high-bandwidth, low-latency satellite network, to deliver 4G/5G connectivity to remote areas where fibre or microwave solutions are costly or impractical.
- **Xcel Energy**, in the US, has deployed 2 million Gen5 Riva distributed intelligence (DI)-enabled electric smart meters as part of Itron's Advanced Metering Infrastructure (AMI) and industrial IoT (IIoT) network. This deployment helps deliver cleaner, safer, and more reliable energy to nearly 3.7 million customers.
- **Nokia** launched ruggedized 5G devices to connect, over 5G networks in harsh and hazardous environment like ports, mines, offshore oil platforms, chemical plants etc. driving new innovations like for example, instead of humans driving large earthmovers and equipment inside mines, 5G connectivity will enable remote management of such devices enabling a safer environment.
- **Airbus** operators now use 5G compatible tablets and smartphones at its 5G connected industrial facilities. Airbus has deployed 5G for all its industrial sites.

Impact

- Seamless connectivity across home, community, workplace, remote areas and enterprises for diverse devices enables a connected ecosystem that opens up new opportunities for business.
- The convergence of connectivity, cloud and AI is opening new opportunities for machine-to-machine, machine-to-human communication and industrial automation. Hyper-automation at scale is now possible by collecting data from diverse devices over a digital fabric with scalable computing provided by edge compute and cloud.
- Enterprises are able to provide safe work-environments, especially for field workers and technicians. By analyzing patterns in network performance and equipment data, telecom operators can forecast potential failures before they occur, which helps prevent accidents due to equipment breakdowns.
- As AI becomes powerful, demanding computing power, networking innovation is key. Limitation of Moore's Law means high-performance computing will need to be reimagined through cluster computing that is powered by reliable and low-latency communication.

Tech

- **Satellite Communication and Non-Terrestrial Networks, Low-Earth Orbit (LEO) and High Altitude Platforms (HAPS):** Non Terrestrial Networks, Starlink Satellite technology, High-Altitude Platforms, Amazon's Project Kuiper, Iridium's direct-to-device NTN service,, Boeing Satellites, Airmo, Blackshark.ai, E-space, Sateliot
- **5G/IoT for Industries:** 5G for maritime, 5G in railways, 5G in manufacturing for Airbus, Ericsson 5G RedCap, Qualcomm 5G IoT, Nokia 5G Industrial devices, GitSat, Galileo Satellite Network
- **Smart Digital Infrastructure**: Omnispace, ABB Smart Robotics, Lilygo, Myriota, Latent AI, SCADAfence, SimpliSafe, Elevat, OQ Satellite 5G IoT, Xcel Smart Meters
- **Connectivity -Powered Distributed Intelligence:** AI for sustainable networks, EdgeConneX, Qualcomm IoT AI, Itron Distributed Intelligence, Ericson smart power grid, Landis+Gyr Distribution Automation
- **Connectivity to Break Compute Limitations of AI:** UltraEthernet, RoCE

Jennifer Marchand
Expert in Residence

Ops, AI Did it Again

IT operations that are proactive, adaptive, self-learning and action-oriented, now evolve towards seamless 'NoOps' autonomy, complements of agentic AI

So many platforms, applications, services, industrial assets, and edge devices to take care of securely. And all of that in an increasingly hybrid, multi-cloud context. Enough to lose your senses. It's the perfect playground for AI to take charge of the complexity. AI recognizes patterns, generates insight, and detects disturbances in real time. Then it looks through even the opaquest of systems, predicting what will happen to allow for timely measures, and suggesting what should be done. And all the while it learns, becoming more and more autonomous in running its IT operations. Oops, is that infrastructure taking care of itself?

What

- In increasingly connected environments, AI in IT operations (AIOps) offers big data management to handle more data, more noise, and more variety of inputs across cloud workloads, infrastructure workloads, applications, and monitoring systems.
- AIOps ingests data, detect patterns, and predicts events. With generative AI, AIOps can also explain complex issues and AI-driven actions, increasing trust and collaboration.
- However, new dimensions and considerations need to be designed around efficient use for large language models to avoid counteracting the savings found through their intelligence, including model training costs, AI infrastructure, and data storage.
- This is a fast-evolving field and it remains to be seen if the use cases developed with gen AI will drive enough insights and actions to outweigh the significant costs and risks. The potential is great and far-reaching including in the areas of health and sustainability; however, the energy consumption trajectory is high. Therefore, well architected and designed systems are crucial.
- The potential for both good and bad in IT security is another important consideration. Strategically leveraging AI aware systems that learn operational anomalies and react in real time is the game changer.

Use

- **stc Group**, a Saudi Arabia-based telecom company, implemented Nokia's MantaRay Cognitive SON, an AI-powered self-organizing network solution, to improve its commercial network performance. During a high-traffic period, the solution processed over 10,000 actions, boosting cell utilization by 30% and user throughput by 10%.
- **Formula 1** is collaborating with AWS to use generative AI for root cause analysis (RCA) to quickly identify and resolve off-track technological issues. The tool allows F1 to query logged data using natural language, improving system error investigation, minimizing downtime, and ensuring smooth race operations.
- Nokia Bell Labs and **Vale**, a Brazil-based global mining company, are implementing a cognitive monitoring network service. This service will enhance the performance, reliability, and safety of mining operations by analyzing data from production systems, such as hauling trucks and autonomous drillers, in relation to network KPIs.
- **Cambia Health Solutions** implemented BigPanda's Incident Intelligence and Automation, powered by AIOps, to streamline their noisy and fragmented alert environment. By normalizing, deduplicating, and filtering monitoring data, BigPanda reduced alert noise by 83% and enhanced alert enrichment. This allowed Cambia's NOC to automate processes and identify critical alerts within 30 seconds. The NOC achieved a 95% overall SLA and a 91% critical alert SLA.
- US-based **Prosperity Bank** deployed BMC Helix AIOps to gain visibility across the bank's infrastructure and application stack, identifying issues proactively before they become a problem.

Impact

- AI is transforming IT Service management, with AI bots now routinely automating remediation, reporting, health checks, and service requests.
- Organizations benefit from AIOps across monitoring, service desk, and automation to drive faster detection and resolution of issues and shift from reactive to proactive alerting.
- AIOps offers greater observability, with anomaly detection, event correlation and analysis, and root cause analysis.
- Generative AI is supercharging conversational AI by expanding the robustness of use cases handling more varied and nuanced interactions to better understand intents, retaining context through a conversation.
- Beyond RPA mimicking human clicks on a UI for process automation, today, conversational AI and gen AI allow for intelligent process automation driven by cognitive processes orchestrating cross systems API execution.
- Multi-agent and agentic models will transition from the role of supportive tools to that of independent agent with increased process execution capability due to their ability to understand goals, interact with their environment, and reason.

Tech

- **AIOps:** MoogSoft, Splunk Cloud, Aisera, ScienceLogic, AIOps, BigPanda, Sumo Logic, Helix Platform, PagerDuty, Ignio AIOps, Interlink Software AIOps Platform, Nokia AIOps
- **Conversational AI:** Amazon Alexa, Google Dialogflow, IBM Watson Assistant, Microsoft Azure Bot Service, OpenAI GPT-4, Rasa, SAP Conversational AI, Kore.ai, LivePerson, SoundHound Houndify, Pega Chatbot, Inbenta, Amelia, Cognigy, Ada, Mindsay, Teneo by Artificial Solutions, Botpress, Viasay
- **Gen AI:** GitHub CoPilot, ChatGPT, CodeWhisperer, Code Llama, Google Gemini Pro, Anthropic Claude, Stability AI (Stable Diffusion), DALL·E 3, MidJourney, Jasper AI, Cohere, Adobe Firefly, NightCafe Studio, PaddlePaddle (by Baidu), Soundraw, Deep Dream Generator, Pictory
- **IOT:** Azure IoT Edge, AWS IoT Greengrass, ClearBlade IoT Core, Siemens Mindsphere, PTC ThingWorx AI, Bosch IoT Suite, C3 AI Platform, GE Predix AI IoT
- **Cortex/MDE:** Microsoft Azure Cortex, Cortex by Scale AI, Palo Alto Cortex XSOAR, Cortex by Neuralink, NVIDIA Isaac Cortex, Aera Cortex, Cortex.io, Eclipse Modeling Framework (EMF), Eclipse Papyrus, Acceleo, Modelio, ATL (Atlas Transformation Language), Unified Modeling Language (UML), MetaEdit+, GenMyModel, Sirius Open Source, Xtext

Bernd Wachter
Expert in Residence

Simply the Edge

Core edge technologies like 5G, system-on-a-chip, and embedded AI have advanced, bringing the power of IT infrastructure close to real-world operations and people

It's quite the page-turner. We move beyond limits, reach the edges, at higher amplitudes. Edge core technologies, such as 5G, system-on-a-chip, and embedded AI, have matured, pushing the boundaries of central IT infrastructure closer to the 'real' world of business operations, and real people. Technology has hit the ground, embedded in our surroundings. And the tipping point is right here; where compute, storage, and processing power join at the source of data collectors, sensors, and actors — that's where innovation ignites. It's where the cloud meets its edge cousins of 'mist' and 'fog'. Simply put, with IT infrastructure now finally turned into a genuine 'infostructure,' it's so much better than all the rest.

What

- The edge evolves to a ubiquitous infrastructure everywhere, powered by new distributed hardware components. Combing low-power CPUs, GPUs, everything on a chip (SoC), embedded AI and battery improvements, make the infrastructure more powerful than ever.
- AR/VR, ambient computing, autonomous driving, space tech and connected health, all require fast data processing at the network edge. A powerful edge infrastructure, built on a backbone of network technologies like 5G or satellite communication, is key to realize future breakthrough use cases.
- As humanoid robots, drones or traditional manufacturing components get connected in a secured way, oiled by real-time data through improved interfaces between Operational Technology (OT) and Information Technology (IT) — it allows for future embedded AI technologies at every device.
- EdgeOps will evolve to guarantee a secure and continuous delivery of up-to-date software releases and device firmware upgrades, up to and beyond the edges of the existing IT infrastructure to support AI, sensor-based applications, or control data.
- Pervasive computing needs new talent across all industries: unified experts in core IT-technologies like cloud, edge integration and operations, networking, embedded software deployment while bridging across IT and OT domains.

Use

- **McDonald's** new Google Cloud's edge computing solutions is enhancing platforms by integrating information storage and computing power directly into restaurants. They deploying across thousands of McDonald's locations, enabling both cloud-based and local software and AI solutions.
- **Assistance Publique Hôpitaux de Paris** deployed socially-assistive humanoid robots for routine tasks and interaction with patients. The robots greeted patients, answered questions, and provided directions.
- **Bosch Research** is working on the CUBE-C — Cyber-Physical Systems (CPS) Cloud Continuum project to create an energy-efficient and cost-efficient solution for safety and real-time-critical software functionalities using edge/cloud computing power, all with reliably low latencies. Over 100 companies and research institutions are involved in the European IPCEI-CIS project.
- **Nature Fresh Farms**, a Canada-based greenhouse farm, deployed AI-enabled, edge farming solutions powered by Intel and OpenVINO, tracking and managing everything from the farm's climate and humidity levels to the trucks produce that is shipped on.
- **Topcon Healthcare**, a US-based medical equipment manufacturer, partnered with Microsoft to deliver AI-powered Healthcare from the Eye early detection. Using the Nuance Precision Imaging Network and the THI Harmony platform, patients and providers can participate in pre-screening for systemic and neurological diseases via a robotic, rapid, and non-invasive eye scan.

Impact

- Ubiquitous compute with a strong edge-powered backbone is at the tipping point to realize breakthroughs across industries. Space tech's new telematic solutions reducing traffic and emissions, or bio tech with connected health allowing personalized medicine and treatments.
- The edge evolving as an enabler and accelerator for AI, with the ability to locally process and apply embedded AI technologies — machine-to-machine interaction or directly use in human-machine interaction with smart devices.
- Decentralized processing and storing (raw) data only once on low-power edge devices will reduce IT-caused emissions in all scopes.
- Sovereign edge is meeting new regulatory demands. Autonomous, independent systems and the processing of confidential workloads are working seamlessly with a sovereign cloud/EdgeOps operating model.
- Ambient computing is evolving as a new standard for human-machine interaction, fundamentally changing our interacting with IT. New intelligent devices like wearables (glasses, clothes), are integrated in factories, cars, homes, everything connected, will evolve to a ubiquitous intelligent live companion — all edge powered.

Tech

- **Building the Edge:** Fastly Edge Cloud, Intel Edge Cloud, Lumen Edge Cloud, Cloudera Edge Management, , NVIDIA Enterprise Edge Computing, FOG Project, Azure Stack Edge, AWS IoT, Google Distributed Cloud
- **Management and Connectivity:** thin-edge.io, Belden Horizon, MQTT Sparkplug, EdgeIPS Pro, ServiceNow OT Management, Axiom Space, Virgin Galactic, OneSat,
- **Autonomous Devices:** OTTO by Rockwell Automation, MiR (Mobile Industrial Robots), Continental's AMRs, Geek+ Robotics, Atlas (Boston Dynamics), Robonaut 2 (NASA and GM)
- **Embedded AI:** NVIDIA Jetson Platform, Intel Movidius Myriad X VPU, Qualcomm Snapdragon Platforms, Siemens Industrial Edge, Arm Cortex-M55 processor, Edge Impulse
- **Standardizing the New:** The Metaverse Standards Forum, CDISC, Open Geospatial Consortium, NIST SP 800-82 Rev. 3 Guide to Operational Technology (OT) Security

Julian Van Velzen
Expert in Residence

Ok Qompute

New computing architectures are emerging, such as in Quantum, AI and neuromorphic chips — rewriting the rules and possibilities of innovation

In the world of more Moore and more than Moore, computing evolves by embracing entirely new architectures. Quantum, AI, and neuromorphic processors are shattering limits, with quantum supercomputers handling complex tasks, GPUs crunching AI equations, and CPUs conducting the flow. It's beyond raw power, this tech renaissance is reshaping infrastructure, challenging cryptography, and sparking breakthroughs in materials science. As post-quantum cryptography emerges to secure the future, the convergence of bits, neurons, and qubits takes us beyond the familiar. It's computing reimagined. Quite OK.

What

- As bits, neurons, and qubits continue to develop at their own pace, we can expect silicon innovation to continue; the end of Moore's Law, the law that describes the exponential growth in number of transistors in a chip, isn't here just yet.
- Platforms, beyond von Neuman architectures and silicon, are making their way to the market. Neuromorphic computing is designed to mimic the brain, while quantum computing promises computation heavy lifting. Indeed, there's more of Moore's Law and more than Moore's.
- Say goodbye to homogeneous computing systems and embrace the future with heterogeneous computing. There won't be one chip to rule them all. Instead, it's horses for courses.
- Currently, 40% of all supercomputing time goes to understanding atomic behavior. Improved capabilities go beyond reducing wait times. Instead, it will enable new materials, applications and business models.
- On the flip side, within a decade, quantum computers may break asymmetric encryption, the foundation of the internet. Quantum-safe cryptography is available, but implementation won't be so easy.

Use

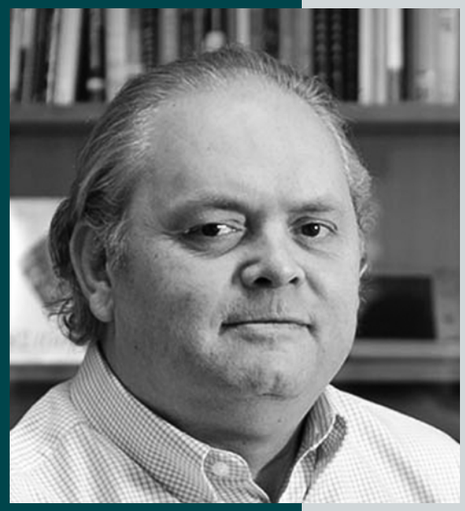
- **Unilever** is leveraging Microsoft's Azure Quantum Elements to speed up scientific discovery. Through Datalab, Unilever's global virtual lab, Azure Quantum Elements powers hundreds of thousands of new simulations.
- **Capgemini** announced a new initiative with The Defense Advanced Research Projects Agency (DARPA) to investigate the use of quantum computing in the field of carbon capture. Capgemini will focus on high-impact exploratory efforts to identify breakthrough technologies to accelerate innovation.
- **Deepmind**, an AI company by Google, received the Nobel Prize for chemistry this year for their work in protein design. The team developed an AI model to solve a 50-year-old problem: predicting proteins' complex structures.
- **NIST** has standardized post-quantum cryptography and global technology players like Zoom Video Communications deployed post-quantum end-to-end encryption (E2EE) for Zoom Meetings, with Zoom Phone and Zoom Rooms to follow soon. When users activate E2EE for their meetings, only the participants can access the encryption keys used to secure the meetings.
- **Classiq**, an Israel-based quantum software company, partnered with NVIDIA and BMW Group to optimize mechatronic systems using quantum computing. Redesigning the architecture for electrical and mechanical components to enhance efficiency, minimize energy waste, and improve electric vehicle performance.

Impact

- Do you think your business is not in the material business? Think again. Innovations in chemistry and material science are estimated to have an impact on 96% of all manufactured goods, which impact 100% of humanity (Microsoft Quantum).
- Using today's technologies, Research & Development organizations already report significant improvements. Exascale computing systems in use already host a variety of chips, including a variety of CPUs and GPUs.
- Future systems will incorporate quantum processor units, QPUs, while neuromorphic processor units, NPUs, finding their niche in energy-efficient edge applications. Advanced networking capabilities such as InfiniBand stitch it all together.
- Enterprises can no longer postpone the transition to quantum-safe technology. Quantum readiness is not just a luxury but a necessity, as new regulations are here, bad actors are aiming for the store-now-decrypt-late method.

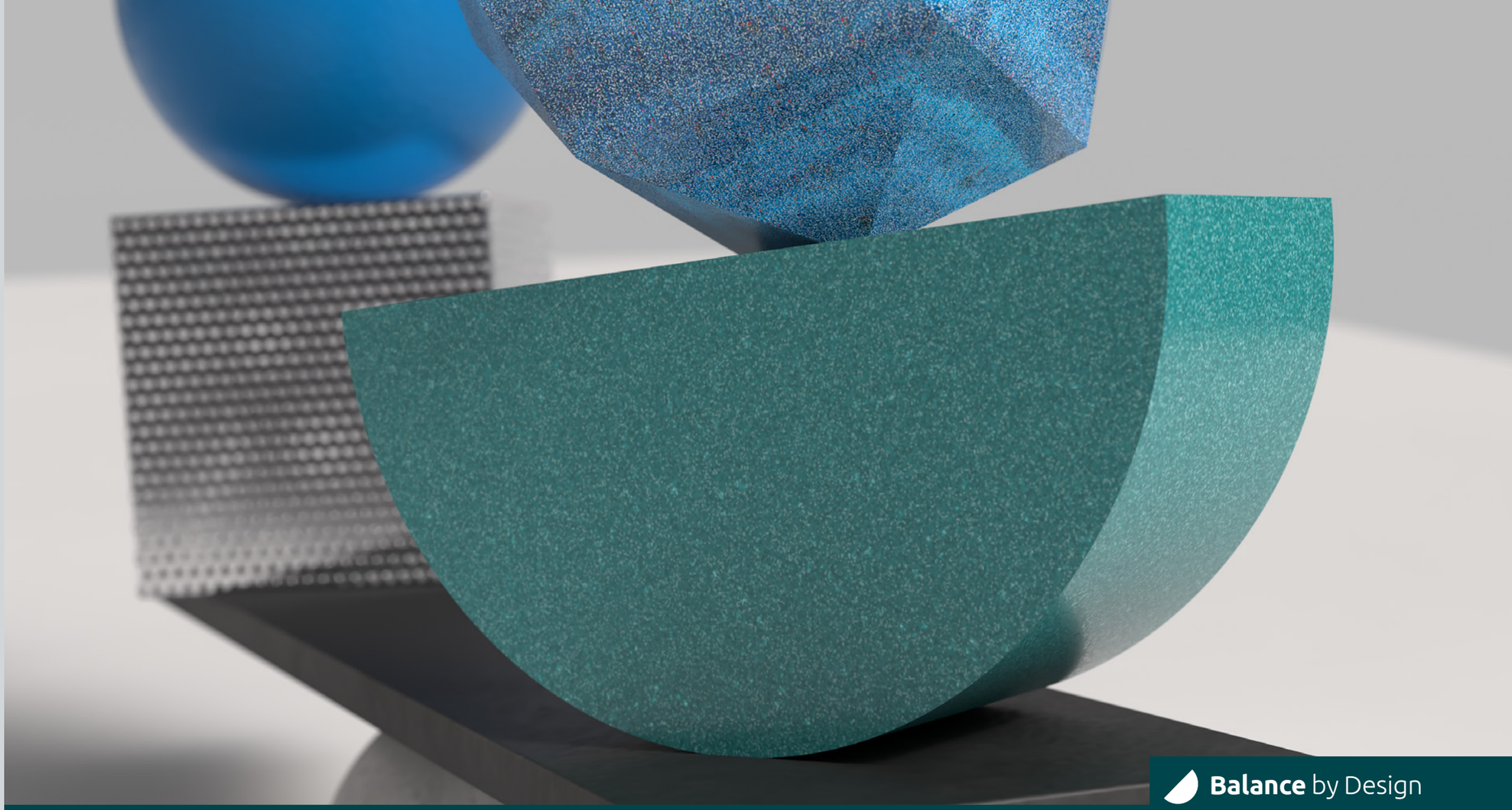
Tech

- **Quantum Hardware and Software:** IBM, QCI, Rigetti Computing, PASQAL, Quantinuum System Model H2, IQM, IonQ, Xanadu QuERA, QCTRL, Classiq, D-Wave Quantum Ocean, Xanadu Pennylane, QCWare Promethium
- **Neuromorphic Hardware and Software:** IBM, Intel Loihi 2 and Lava, Brainchip Akida, SynSense, Innatera Nanosystems, Prophesee, General Vision NeuroMem
- **High Performance Compute and Networking:** Supermicro HPC, AWS ParallelCluster, Azure HPC, HPE Cray Supercomputing, IBM Spectrum Computing Suite, Penguin OCP Servers, ThinkParQ, Rescale Cloud HPC Platform, Altair HPC and Cloud
- **Scientific Research Software:** QC Ware Promethium, Azure Quantum Elements, Qsimulate, ProteinQure, QC Ware Forge, Good Chemistry, IBM Qiskit Runtime
- **Post-quantum Cryptography:** IBM Quantum Safe, Thales, PQShield, CryptoNextx
- **Hyperscalers:** Azure Quantum cloud service, Amazon Braket, AWS High Performance Computing, Google Quantum AI, Google Quantum Virtual Machine
- **Quantum Cloud Services:** IonQ Quantum Cloud Service, Xanadu Quantum Cloud, Forest/Quantum Cloud Services (QCS), QANplatform cloud service



Michiel Boreel
Expert in Residence

Balance by Design



Breakthrough technologies are rewriting the playbook, turning once-impossible goals into today's ambitions. Artificial Intelligence, edge computing, and mixed realities are no longer the future. They're now the tools reshaping enterprise innovation. But navigating this new landscape isn't a straight path; it's more like walking a tightrope, balancing competing forces at every step. Short-term wins must align with long-term visions, centralized control must coexist with decentralized agility, and innovation must remain grounded in sustainability. The real challenge? Crafting technology that's purposeful yet spontaneous, value-rich yet frugal, and above all, human-centered. Get the balancing right, and the tightrope turns into a runway — propelling businesses toward their boldest aspirations.

As was discussed in the editorial introduction to this year's TechnoVision, the balances to maintain are under the influence of the constant motion of the pendulum. In that sense we should talk about dynamic balances as opposed to static balances. Dynamic balance refers to the ability to maintain stability and control while in motion. In case of the human body, it involves the coordinated interaction of the muscles, sensory systems, and the nervous system to adapt to changes in the body's position or speed. Dynamic balance is crucial for activities like walking, running, changing direction, or any movement where the body is not stationary. It contrasts with static balance, which is the ability to maintain stability when stationary or standing still.

Just like the human body, the organization is also in constant motion, so we should strive for dynamic balances in each of the principles. This will result to an organization that is able to innovate at the rate of technological change.

This quest for balance in so many different dimensions is more than a necessity; it's a call to action. TechnoVision not only identifies emerging technology trends (the 'what') but also crafts a vivid roadmap to constantly maintain this delicate equilibrium within organizations (the 'how'). This roadmap, **Balance by Design** is built with purposeful design elements, and promises to guide executives, architects, and technologists on a transformative journey. If nothing else, it provides a checklist of 7 areas to consider when evaluating a program or project, a portfolio, an architecture, or an innovation initiative.

Presented on a single page, each **principle** is deliberately contrasted with an **antiprinciple**: the opposite of the principle, a statement that more often than not, strikes the reader as uncomfortably familiar. The **context** then positions the principle, before **living the principle** shows how to apply the principle on a continuous basis, and the **openings** propose the potential first steps for any organization, like the opening moves of a chess game.

The new principle of **augment ME**! builds on TechnoVision's theme of last year. It invites us to consider the augmentation power of technology (notably AI) for every aspect of business and its technology solutions, including the IT and solutioning processes themselves. It addresses the need to change our traditional views on the notion of knowledge, understanding and — ultimately — judgement. We've come to increasingly rely on technology to analyze, decide, and now act with agency on our behalf. This stipulates the need for new balancing, creating a symbiosis, between human and machine intelligence to come to proper judgement, to navigate different levels of confidence. Ultimately, human and machine intelligence augment, rather than replace each other.

Building on that, the other new principle, **Real <-> Smart**, challenges us to keep balancing between genuine human ingenuity, shiny artificial brilliance, and the way they can reinforce one other towards a better future. For that, organizations need to think less quick fix and more long game. This means borrowing from nature's playbook itself — adapting, renewing, and thriving in harmony rather than bulldozing ahead. Blend the creative flair of people, the relentless efficiency of AI, and the quiet wisdom of ecosystems to craft solutions that are as sustainable as they are clever.

It's tempting to think that simply selecting a few breakthrough technology trends will transform the organization, but in fact, the success of technology-powered change is more often dependent on the mindset, culture, and balanced considerations of the organization that is additionally constantly in motion. This is why many practitioners of TechnoVision have found that the **Balance By Design** container is the most pivotal to success.

Patrice Duboe
Expert in Residence

Technology ∈ Business

The Principle

Move from alignment to unity of business and IT, creating a seamless technology business of strategy and operations, compliant with the new now.

'Every business is a technology business', is how our odd, slightly misused mathematical notation should be read. With the ever-growing dependence on technology, the worlds of IT and business migrated, sometimes reluctantly, from isolated compartments to fully aligned entities. But now, an 'All Ops' approach is required with full, mutual, and deliberate convergence business and IT without friction or middle persons. They move and act as one.

The Antiprinciple

Clinging to outdated communication channels and rigid handovers, which can hinder the fluid exchange of ideas between business and IT, poses a considerable pitfall. Relying on the conventional periodic business and IT alignment by translating an enterprise's strategy into an IT strategy and priorities is simply too slow and harms an organization's manoeuvrability so desperately needed in times of fast, unpredictable changes.

The Context

The responsiveness, speed, and adaptability needed to thrive in today's technology business context does not allow any obstruction, delay, or noise between the stakeholders involved. Any technology business strategy should be deployed, both fluidly and rapidly, in both business and IT operations, connected as one, as it evolves and iterates repeatedly and continuously.

This 'All Ops' approach, continuously adjusting and delivering on strategy, cannot afford any loss in translation along the way. Cross-disciplinary teams work jointly on products, rather than on projects that think of creating experience and outcomes, with a potentially unlimited lifecycle, guided by shared budgets and tangible business value streams. Technology becomes more democratized, and internalized as all involved learn from each other's roles, perspectives, and skills. Because after all, the whole organization should move as one.

Live the Principle

1. **Empower the business.** Shift ownership of and responsibility for technology business solutions, products, and change towards the actual business domains.
2. **Create technology business product teams**. Move to continuous product delivery, driven by cross-organizational, autonomous, 'All Ops' teams with allocated budgets.
3. **Democratize technology.** Make self-service of IT capabilities by the business the default, for example in areas such as data, application services, and process automation.
4. **Go beyond conventional governance.** Enable technology business product teams to act quickly and autonomously on top of predefined policies and authority levels.
5. **Think platforms.** To enable an organization to innovate at the speed of technological change in a business environment requires resilience to deliver results, no matter the crisis. It also needs adaptiveness — changing to meet constantly shifting demand. And last but not the least, creativity, to re-invent continuously. To achieve these, a unified platform both in process and in data is required. On top of this fast and effective practices can be develop that deal with today's time compression.

The Openings

- Build generic, enabling platform services but make absolutely sure one or more business domains sponsor, adopt, and apply each service right away.
- Transition incrementally, introducing technology business product teams one at a time, considering the availability of relevant platform services.
- Make technology business product teams the default for new corporate products and services, especially when innovative technology enables them.

Michiel Boreel
Expert in Residence

augment ME!

The Principle

Leverage rapidly emerging forms of AI-generated knowledge and insights, even in the absence of complete understanding and transparency ultimately applying a complementary, symbiotic form of judgment between humans and AI. Understand that one will never fully replace the other and strive towards mutual augmentation.

AI is enlightening us about the inherent complexity of the world around us, revealing that it cannot be neatly encapsulated within rigid frameworks and that any model, however sophisticated, will always remain an approximation of reality. This is evidenced yet again in breakthroughs in generative AI and multi-modal agent systems. As we are increasingly becoming reliant on these systems, the question arises to what extent we trust them to provide knowledge and take actions on our behalf — with our ways of command and control becoming irrelevant and passion-killing. If we aim to address some of our most pressing business and societal challenges, we must embrace the evolving forms of augmentation; even sometimes if it is in the absence of complete understanding and control but while always being responsible and ethical. The ideal outcomes arise at the intersection of human and machine intelligence. Sound judgment then, with understanding the constant pendulum swing between trust and control, is the key feature of this symbiotic, co-creation process.

The Antiprinciple

Over-emphasize the importance of clarity, explainability and openness in AI-generated insights and consider conclusions trustworthy only when the algorithms used for their derivation are transparent, reproducible, predictable, and subject to human oversight. Alternatively, fully trust any AI-driven decision or action.

The Context

The vast reservoir of information and data accessible through the internet, coupled with the emergence of infinite machine intelligence and deep learning algorithms, is challenging the traditional concept of knowledge. Gone are the days when analysis outcomes were only considered knowledge if they could be encapsulated in universally applicable principles or, preferably, expressed in unbiased scientific equations. Navigating the modern digital realm is akin to exploring the vast expanse of space. Traditional knowledge repositories, like books, are now overshadowed by the intricate web of the internet. As we shift to 'hyper-linked thinking', it becomes apparent that the immense complexity of AI-enhanced networks can be challenging for mere human comprehension. Yet, while daunting, this depth offers businesses a dynamic, multi-layered understanding that mirrors the intricacies of our ever-evolving world.

The traditional methods of control are therefore quickly growing out of date: strict top-down oversight will stifle agility in this new paradigm. Yet totally unconstrained autonomy poses its own risks if ethical AI development and deployment principles are not ingrained across organizations. It demands an enterprise-wide approach to good judgment, as a symbiotic collaboration between humans and their AI systems. This is a shift that mandates a comprehensive people change, equipping workers with the judgment prowess essential for the AI era.

Live the Principle

1. **Built in trust and responsibility**, founded on a code of ethics for a fair, safe, and sustainable usage. Prevent AI from producing inaccurate information (unless this is acceptable for certain use cases, for example in experimental R&D, free form brainstorming etc.) or generating responses that contradict the company's values and purpose.
2. **Leave micro-approving choices**, as leadership should focus on empowering workers with mentioned skills at all levels, acknowledging the continuous evolution of AI and other breakthrough technologies is necessary.
3. **Make a clear distinction between the unknown and unknowable**, for unknown areas, new knowledge incessantly needs to be found. It does not matter whether it comes through deterministic data or probabilistic synthetic data.
4. **Leverage the emerging technology guardrails to the full extent**. AI-technology is constantly evolving and providing new guardrails to improve the accuracy of the insights provided. It is key to keep updating the systems to the latest state-of-the-art.
5. **Keep the human in the loop** to double-check and validate AI-generated content, especially where potentially inaccurate AI models (such as Large Language Models) are involved.

The Openings

- Revisit your existing code of ethics for AI (if any) to filter out unnecessary business-preventing elements, while sticking to non-negotiable ethics foundations.
- Assess new or existing local or international rules and regulations (such as the EU AI Act and IEEE Ethically Aligned Design) for guidelines on how to categorize AI knowledge and applications in different risk categories (including minimal risk).
- Consider tools to audit AI systems for transparency and manageability, even if the internal workings of these tools themselves may be too big to know.
- Provide training on how to set the right context for human-AI decision-making — this involves explaining appropriate boundaries for prompts and framing inquiries responsibly.

James Robey
Expert in Residence

Do Good, Do Less, Do Well

The Principle

Make your organization thrive by embracing initiatives that create a positive social and environmental value alongside economic value, while rejecting activities that damage the biosphere or destabilize society and compromise humanity.

Technology is a remarkable thing. Without the innovation we've seen over the past 200 years, we would be living very differently, if indeed we'd be living at all. Certainly, there wouldn't be nearly 8 billion of us on planet Earth! However, modern technology operates at such a staggering scale, that for the first time humanity is altering the very planetary ecosystems critical to our well-being. So large is this scale that scientists have defined our era as the Anthropocene — humanity's impact on the planet is the dominant. Now is the time to apply the remarkable capabilities of technology to create a future for the benefit of every human being.

The Antiprinciple

Unleash technology to maximize economic growth whatever the social and environmental costs. Businesses should focus only on profit. Social and environmental concerns should only be considered if they enhance short-term profit.

The Context

Our biosphere is sick. Of the nine planetary boundaries critical for humanity's survival on planet Earth, seven have been broken and two are almost broken! Furthermore, of the 17 Sustainable Development Goals (SDGs) set by the United Nations which cover both social and economic outcomes, only 17% are on track to be met by 2030.

In this context, IT has immense potential. GESI (Global Enabling Sustainability Initiative) has identified that technology can positively impact all 17 of the goals and over 50% of the 169 specific targets sitting under the goals. Technology can improve crop yields, design medicines faster, improve the efficiency of almost every process, make supply chains more resilient, and simultaneously less carbon- intensive. At the same time, technology is also enabling individuals to learn and families to connect instantly across the globe.

Whilst this is positive, it must be acknowledged that IT also has its own impact consuming energy, natural resources, and creating carbon emissions. Current estimates suggest 3.7% of global CO_2 emissions are associated with IT and the rapidly growing use of AI that requires an increasing amount of energy to train the sophisticated models. Indeed, if the IT industry was a country, it would be the third largest electricity consumer in the world. Clearly, IT itself must be delivered in an optimized way alongside making its societal and environmental contribution.

Live the Principle

1. **Understand your current position by assessing your sustainability footprint.** Where are you making negative environmental or social impacts and can you eliminate these while maximizing the positive impacts of your business?
2. **Identify areas where IT can contribute to reducing environmental impacts** (ideally against all nine planetary boundaries):
   - Firstly, how you can optimize your IT estate to minimize its operational impacts — e.g., consolidating your application portfolio or migrating to new technology to reduce environmental impacts.
   - Secondly, consider how IT can reduce the impact of your wider business — e.g., leveraging digital twins to identify efficiencies or applying intelligent routing to your logistics.
   - Finally, investigate how your application of technology can help your customers reduce their impacts — e.g., providing smart meters to help domestic energy consumers reduce their consumption.
3. **When designing new products and services, assess their benefits** against the 17 Sustainable Development Goals. If it's not going to make a positive contribution across the goals, consider redesigning.
4. **Ultimately, reject non-sustainable business ideas and technology**. Align your business initiatives so that they create positive social and environmental value alongside economic value.

The Openings

- Educate your teams on the SDGs and encourage active debate about how your products and services are making a positive contribution.
- Undertake a systems audit to identify marginal or obsolete applications.
- Be critical when considering new applications, especially concerning AI, if the intended results justify the use of resources. If not, then do less with less.
- Focus on creating positive social and environmental value alongside economic value.

Thilo Hermann
Expert in Residence

Be Like Water

The Principle

Ensure the built-in 'water-like' capabilities of agility, flexibility, responsiveness, resilience, and openness.

The idea of being adaptable and flowing, like water, is a powerful metaphor in today's uncertain times of permacrisis. A technology business must embrace continuous, unexpected change. It involves rapid adaptation and ongoing experimentation by design. The technology infrastructure and applications landscape need to be upgraded to a flexible digital platform, ready to adapt to whatever requirement, opportunity, or challenge that arises. The organization must live and breathe agile principles, not only as the forte of the IT department and a few business representatives but also as the overall enterprise mindset. Furthermore, adopting open standards allows the organization to harness external innovation effectively, offering an array of attractive services that invite collaboration, both internally and externally. To innovate at the speed of technological change and behavioral change of your customer, you'll need a fluid and porous organization.

The Antiprinciple

Continue to invest in the monolithic, unruly, intractable, closed, rigid applications that severely limit the strategic manoeuvrability of the enterprise and refuse to solve the technical debt.

The Context

The reality is that today's world is more uncertain than ever for organizations striving for success. The near future may be marked by a series of crises and opportunities. Whether it's environmental issues, energy crises, disrupted supply chains, geopolitical turmoil, or technology breakthroughs, the world is defying predictions, characterized by brittleness, anxiety, non-linearity, and incomprehensibility.

In this landscape, traditional prediction becomes futile, giving way to the importance of experimentation and swift adaptation. Organizations must take on various forms, being resilient, adaptive, and creative. In the realm of a technology business, agility hinges on technology adaptability and seamless connections with internal and external stakeholders. Providing a unified experience for customers, partners, and employees necessitates effortless connectivity across industries. Applications should be designed for disruption and change, featuring open connectivity as a standard. Various technologies enable this adaptability, including mesh API-first application services, self-improving IT operations, cloud-native infrastructure, open data-sharing capabilities, distributed networking, AI augmentation, and autonomous systems.

This approach allows continuous corporate reinvention, enabled by technology. But, as we all know too well, transformation will not come through technology only. Neither will it come from implementing agile methodologies and having passionate gurus to drive it. A widely carried corporate mindset that embraces and expects change, rather than demonizing it, is needed.

Live the Principle

1. **Consider your IT infrastructure as digital assets**. Manage them just as carefully as you manage your physical assets.
2. **Architect to adapt**. Follow architectural patterns that enable an agile, distributed mesh, such as microservices; look for AI to drastically improve responsiveness. Re-architect your platform to evolve easily and integrate new partners, outside resources, providers, clients, and new services in the shortest time possible.
3. **Constantly evolve practices** like agile solution delivery, advanced analytics and AI, and hyper automation drive on top of the unified digital platform.
4. **Systematically adopt** open standards and state-of-the-art technologies — as a standing invitation card.
5. **Augment the business value of your APIs and data-sharing services**, evolving from technology-coupling systems into business-partnering vehicles.
6. **Assume processes and systems will be disturbed** and may even break. Build in measures to deal with failures and learn from them to improve resilience.
7. **Search the sweet and sour spots**. Maintain a heatmap of potential changes, for example, due to legislation, future products and services, or new partners.
8. **Prepare your change A-Teams**. Set up unified, cross-organizational teams that can absorb continuous change and act right away, especially when it's not planned.
9. **Rename your platform to Unified Technology Business platform** — designed, developed, and operated with, and for technology-driven business purposes.

The Openings

- Move from project to product thinking. Realizing that operations and applications always evolve, rather than end up in a final state, trains the adaptability muscles.
- Move from solution to platform thinking. A solution becomes only a temporary aggregate, built on a catalogue of agile platform services and capabilities.
- Promote your technology business platform's capabilities and attractions as you would when promoting the glamour of a new product.
- Introduce objectives and key results that speak the language of open connection: business value, time-to-react, fluid workforce, and environmental contribution.
- Become irresistible to the scarce human resources out there, not just by providing security and comfort, but by offering a great work-life balance.
- Bridge strategy and operations. Apply an integrated, DevOps-style mindset to continuously operationalizing strategy in business and IT systems.

Aliasgar Muchhala
Expert in Residence

No Hands on Deck

The Principle

Assume full, hands-free, zero-touch automation as the default for all new technology business processes.

Advances in AI and intelligent process automation make us fundamentally challenge the human factor in any aspect of business, while the scarcity of human skills and resources adds a renewed sense of urgency to the pursuit. And now, we start to explore multi-agent approaches to support processes. The immense possibilities drive us from automation to autonomy — dreaming of an entirely hands-free enterprise. But we should not move so fast just yet. For now, let's benefit from autonomous technology: make it your first choice for all new processes and learn about a renewed 'hands-off-deck' approach, by not doing. However, organizations must take their cultural readiness for automation (in addition to technological readiness) into account.

The Antiprinciple

Leverage siloed datasets to apply AI and intelligent automation for marginal improvements across existing manual, human-dependent processes; firmly keeping all hands on deck!

The Context

By all means, let's take Copernic's advice, and reverse our perspective. We should no longer add snippets of automation and AI to established, human-driven processes, only pretending to enjoy the meager benefits of stepwise optimization. It would be like creating the ultimate horse and cart, applying innovative technology to it (maybe the latest lightweight carriage), and then being genuinely disappointed when it loses in a drag race with a Tesla. Grafting human intervention onto fully automated, AI-centric business processes should be the exception not the rule. We need to design for autonomy, not automation from day one!

It's about getting the maximum impact out of intelligent automation. And it may be the only way too since human resources and skills are scarcer by the day. Hire AI as your main resource while virtualizing and augmenting your human talent. Business needs to learn from their IT teams, who are already surfing the wave of AI-boosted automation for their IT systems and extend that experience across all their technology business processes.

A cautionary remark must be made here. These kinds of transformative automation projects seldom fail because of the underlying technology platform or the lack of technological skills. It is the cultural resistance, fear of job loss, and failed change management that destroy any hopes of reaching the promised benefits. Ample attention needs to be given to the cultural readiness of an organization and its people for automation.

Live the Principle

1. **Transform your IT automation platform** into a fully connected business operations platform, bringing together all underlying business events.
2. **Mine your processes**. Insights enable action; by capturing and analyzing process data, you find the best opportunities for breakthrough automation.
3. **Challenge the heritage**. Even the most established business rules and best practices should be reconsidered for relevance in the era of autonomous systems.
4. **Think autonomy levels**. Like the five levels of autonomy for self-driving cars, you can apply different ambition levels in the move towards a hands-free enterprise.
5. **Keep it human-centered**. Even if no humans are involved, the ethical and emotional checks and balances of the organization must be carefully managed at all times.

The Openings

- Start by looking at the technology business as a whole, rather than getting siloed views of different systems and layers that make up the Process. Then map it back to the key business metrics to help align your automation pursuit with business value.
- Processes that are unsafe to humans, consume excess energy or are particularly error-prone might be viable early candidates for a hands-off-deck initiative.
- Use hands-free technologies for processes that require scarce skilled resources, not only to have a viable pilot ground but also to effectively deal with the challenge.
- Leverage the growing interest in multi-agent approaches to elevate business automation to the strategic level.

Rajashree Das
Expert in Residence

Trust Thrust

The Principle

Power up the entire trust ecosystem, from the organization's core to its edges, securing your existing business and pushing forward to its next permutation.

Technology businesses must be trusted by customers, clients, shareholders, employees, partners, networks, and authorities alike — or there is no business. Period. Simply put, trust is imperative. It must permeate business and technology operations alike. Trust and distrust have an important role in calibrating a person's behavior as an economic actor. And trust us on this one: when applied well, with transparency, reliability, and ethical practices, it becomes an innovative business accelerator leading to positive brand recall and relationships.

The Antiprinciple

Trust your ability to fix issues only as they arise, kicked around by security, privacy, regulatory, and ethical circumstances; or alternatively, hide behind an impenetrable wall of distrust — effectively preventing business.

The Context

All for trust, and trust for all. With breakthrough technologies such as AI breaking new grounds, trust becomes even more paramount. Trust pertains to cybersecurity, guaranteeing users uninterrupted access to secure and trusted data. It also pertains to data privacy, where the proper, transparent use of personal data is always under scrutiny. Then, rules and regulations drive the delicate balance act between competitive innovation on one hand and compliance on the other hand. The ethical use of technology is a core element of the trust equation as well, ensuring it is both human-centered and serving positive futures. It is tempting to delegate the enforcement of trust to either technology (such as zero-trust platforms, AI, and even quantum computing) or to an isolated team of dedicated experts only. But in the end, trust only creates a differentiating thrust if it is entwined with all aspects of technology business changes, with all technology and human stakeholders equally included.

Live the Principle

1. **Embed trust**. All business strategies and initiatives fully embed and address technology-supported trust, as well as the human-centered dimensions of it.
2. **Go full lifecycle**. Trust is an integrated part of the solutions lifecycle, architected, designed, and deployed throughout — rather than check-listed at the very end of a lifecycle iteration.
3. **Trust in the team**. All solutions development 'A-teams' contain cybersecurity/privacy/AI and ethics experts, ensuring the other team members appreciate and embrace trust topics as well.
4. **Evolve the model**. Establish a continuously evolving trust model with principles, guidelines, training, and communication to all levels, using impactful narratives.
5. **Differentiate with trust**. Use the organization's built-up trust as a differentiating quality towards the wider business ecosystem, clients, consumers, and potential employees.
6. **Manage trust and distrust at the same time**. Previously we believed that trust and distrust where the opposite endpoints at one continuum. Neuroscience has taught us that these two very different emotions occur at the same time and need specific targeted measures in parallel.

The Openings

- Expand the solutions development teams to include experts in cybersecurity, data privacy, AI specialists, and ethics, promoting a cross-fertilization of skills.
- Bust your biggest distrust generator, whether it is in cybersecurity, data privacy, AI, or ethics and ensure its resolution is widely communicated.
- Find an organizational system that can safely pilot zero-trust technologies, to try a radically different approach to trust and learn from it.
- To take it one step further, contextualize trust solutions to address industry-specific challenges and regulatory compliance.

Ron Tolido
Expert in Residence

Real <-> Smart

The Principle

Get real about being smart. To strike the perfect balancing between genuine human ingenuity and shiny artificial brilliance, organizations need to think less about a quick fix and more about the long game.

This means borrowing nature's playbook — adapting, renewing, and thriving in harmony rather than bulldozing ahead. Blend the creative flair of people, the relentless efficiency of AI, and the quiet wisdom of ecosystems to craft solutions that are as sustainable as they are clever. Because in the end, being real smart isn't just about impressing the algorithm. It's about playing nice with the planet and future generations, too.

The Antiprinciple

Prioritize short-term gains by over-relying on AI to mimic human capabilities while sidelining the wisdom of people and the resilience of natural systems. Focus on efficiency over sustainability and treat intelligence as a zero-sum game — where being smart means dominating rather than collaborating.

The Context

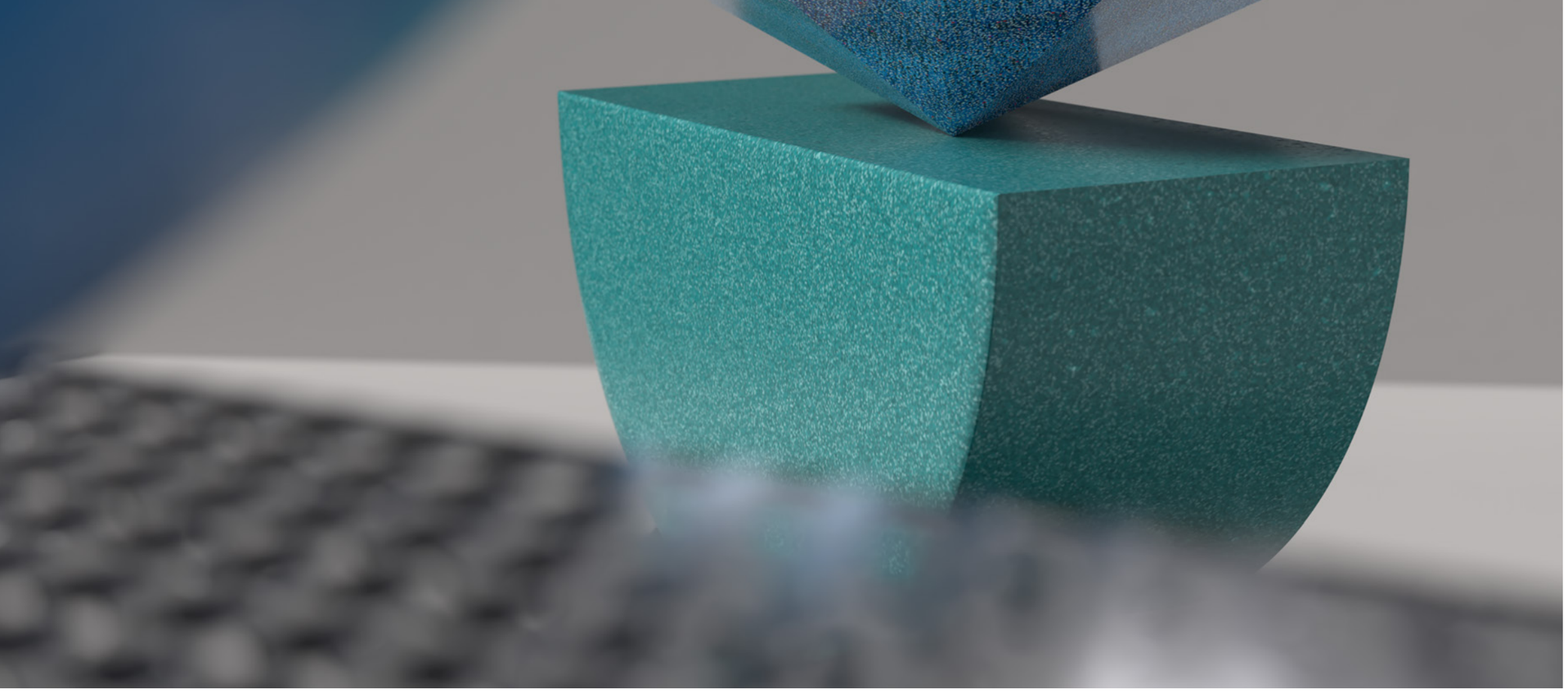
In a world tripping over itself to be 'smart', being 'real smart' is about grounding intelligence in balance, purpose, and a dash of humility. Enter regenerative intelligence, the art of renewing and repairing while in sync with nature, rather than just patching things up with duct tape and data. This principle marries human creativity, AI's relentless precision, and nature's knack for resilience to cook up solutions that don't just work but actually evolve. It's not about AI pretending to be human (or humans trying to out-compute AI). It's about teaming up to be smarter together. Real smart organizations don't chase shiny tech for short-term gains; they design platforms and systems that adapt, thrive, and give back more than they take. It's long-term thinking wrapped in a clever package because intelligence that burns bright but fizzles out isn't just dumb; it's downright self-destructive. Ultimately, real smart is a mindset shift: from dominating to collaborating, from consuming to regenerating. After all, the smartest moves aren't about outsmarting the competition, they're about outlasting the challenges.

Live the Principle

1. **Design with nature in mind**. Build systems that mimic the resilience of ecosystems: adaptive, sustainable, and regenerative, ensuring they give back more than they take.
2. **Blend intelligence types**. Combine human creativity, AI efficiency, and natural wisdom to create solutions that are more than the sum of their parts. Embrace collaboration over competition between these forms of intelligence.
3. **Think long-term, act today**. Prioritize decisions that balance immediate needs with future impact, adopting a mindset of 'long-termism' that outlasts the quarterly report cycle.
4. **Be curious, not just clever**. Embrace complexity and uncertainty as opportunities for learning and growth rather than problems to control or avoid. Stay open to inspiration from unexpected sources, including nature and simple organisms.
5. **Regenerate, don't deplete**. Shift from exploitation to renewal by designing processes, products, and strategies that repair and restore ecosystems, human capabilities, and technological foundations.

The Openings

- Audit your impact. Conduct a sustainability and regeneration audit of your organization's processes, identifying areas where resources, energy, or talent are being depleted rather than renewed.
- Create hybrid intelligence teams. Establish cross-functional teams that blend human expertise, AI tools, and nature-inspired problem-solving methods to address complex challenges collaboratively.
- Invest in regenerative initiatives. Allocate budget and resources toward projects that focus on renewing ecosystems, upskilling human talent, or developing AI solutions that prioritize long-term resilience over short-term efficiency.



A Few More Things

In TechnoVision, we stick to what's solid — innovations ready to deliver immediate or near-future impact. But just before we leave the stage, we'll let the pendulum swing a bit further, stepping into the realm of what-ifs. This is where we explore ideas that aren't quite ripe but show tantalizing promise. Let's face it: nowadays, next week is often tricky enough to predict, let alone a few years furhter down the line. But we can't help ourselves trying, with a nod to the bold and curious, charting the unknown edges of tech where today's improbable might just become tomorrow's indispensable. Sometimes the pendulum swings too far, but who's to say it won't swing back with a breakthrough?

The Space Data Highway

In last year's TechnoVision, we went back to space as a source of inspiration and innovation. Now we have been catching returning rockets with giant chopsticks, while China has seen the dark side of the moon. Data has ventured far beyond our planet. As our reach extends beyond the Earth's atmosphere into satellite networks and space exploration, a new challenge is on the rise: building a data highway between Earth and space. This isn't just about faster communication, it's about rethinking the infrastructure that connects us to the stars. Space is ours: more satellites, more space stations, more space missions, more data — from Earth observation to deep space probes. Current communication methods, however, are constrained by bandwidth, latency issues, and interference. We'll move beyond these limitations and toward a faster, more reliable data highway.

Reaching the moon again is just the beginning. 6-7-8G connectivity, laser-based communications, quantum technologies, and edge computing in space, will be key to building an interstellar network. Balancing between technology and the physical world takes on a whole new meaning in space. Achieving a space highway will need global collaboration across governments, private enterprises, and international space agencies. Open standards and next-gen protocols must be established to future-proof it, ensuring seamless integration across nations and missions — making us interstellar, while benefiting from the innovation on planet Earth as well. No, the challenge isn't just reaching the stars; it's making sure the data keeps up with it

Climate Tech: Code Over Circuits

Our world's environmental (in)balance keeps tipping, from green to black. The climate tech sector is expanding rapidly as the world is a skipping rock for wildfires and hurricanes, creating challenges across industries and straining supply chains. Climate technologies have focused on hardware solutions such as renewable energy infrastructure, electric vehicles, carbon capture, and battery storage. And now we are exploring new nuclear options with Small Modular Reactors as well. But there is another shift going on. Climate tech is going from hardware to exploring the power of software. The evolution from 2025 onwards will be a move towards embracing software innovations that accelerate progress in optimizing climate tech solutions, enhancing scalability, and addressing critical environmental issues. Even though hardware advancements will still be at the base of the transition towards a greener future, it will be just 'echoes of green' if software is ignored.

Software will be the crucial step to drive efficiency and optimization across the hardware solutions. No software, no decentralized energy solutions: software will bind it all together. Software platforms of distributed energy resources like rooftop solar, home batteries, and EV charging stations will be crucial for scaling energy solutions in urban and rural areas alike. But currently, they are not connected — nowhere near the concept of smart grids. Enhancing climate tech with AI will enable new insights. New AI models are emerging to predict weather patterns, optimize energy usage, and identify the most effective solutions for mitigating emissions. These solutions will need new climate software that process large datasets to pinpoint areas of energy waste or inefficiency, enabling targeted interventions and faster innovation cycles.

The future of climate technology is at this intersection of hardware and software. Companies and investors understanding and investing in both hardware and software ecosystems will be key to make the next generation of climate tech a success.

New Materials: Playing with Nature's Code

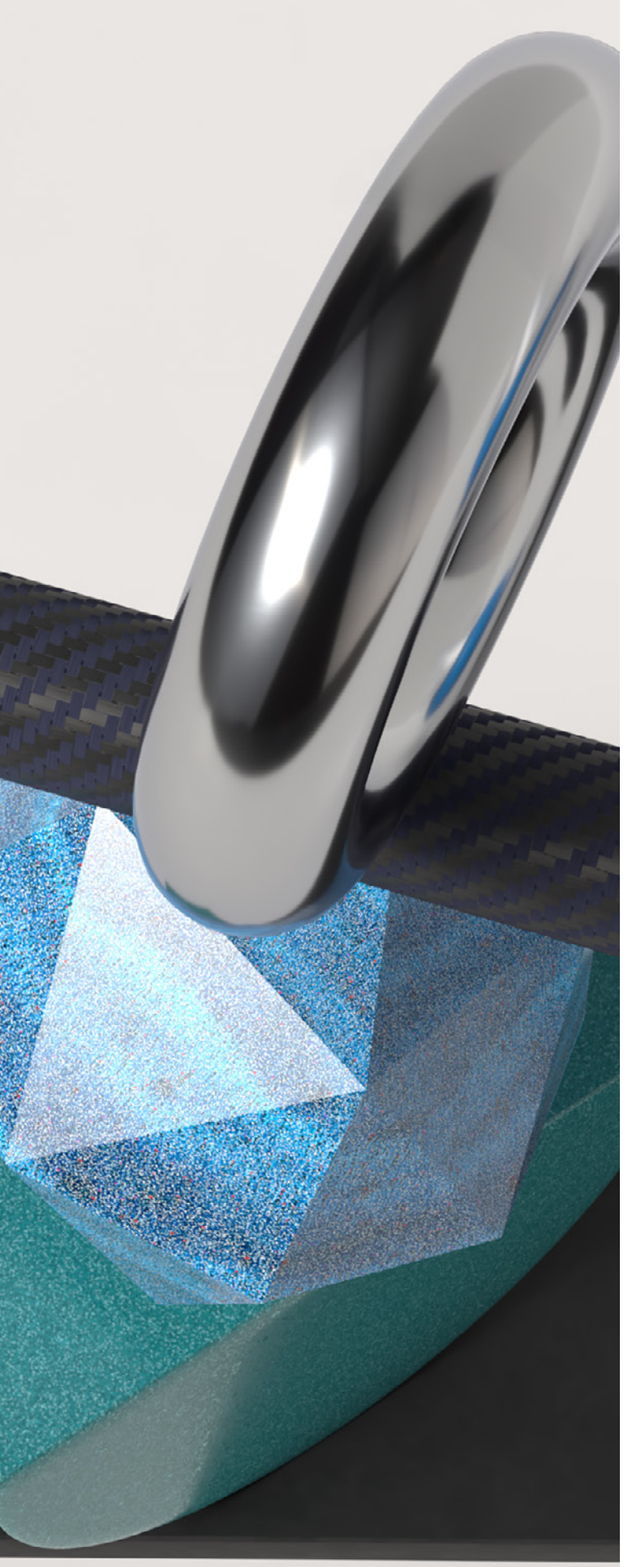
Now, what's the Matter? Beyond synthetic biology, we are diving into the atomic layer of materials. Playing with nature's code, with creation itself. Programmable materials are gaining our attentions. Like masters of the old discovering iron and copper manipulating the surface, we now dive in. Matter itself becomes a new canvas for human ingenuity as we are reprogramming our very matter. We are blending capabilities in biology and engineering with our newfound power of computation. Developers tinkering with code to shape applications, now join scientists and engineers to architect new systems of living or non-living matter.

The recent development in AI, computer modelling and bioengineering is moving synthetic biology from bioengineered organisms to precision designed material that adapt and self-heal, sense, think and even react. Programmable materials go beyond smart materials and they are designed for a purpose, architected with precision and programmed to behave. The points of convergence beween these technologies are peaking after 30 years of research and are taking away the complication, high cost, manufacturing and specification difficulties and the limited adaptability of classic materials.

New developments in biopolymers based on celluloses are architected to purify air. Reprogrammable by design, 3D printed carbon can now sense its own movements and adjust. Programmable soft materials (ergo cell-based blocks) are programmed to attack specific cancers, or to function like protectors in regenerative medicine. In unconventional bioinformatics, organic materials are used for computation purposes. The possibilities are endless, with the lines between biology, engineering and technology blurring increasingly.

These developments will transform Industries in the next decade, with manufacturing shifting to biomanufacturing — which is biodegradable and re-purposeful; silicon moving to bio-circuitry; healthcare producing regenerative, personal and precision medicine; automotive powering its vehicles with bio-batteries.

The pendulum indeed swings back to nature, but this time with the precision of human ingenuity — reprogramming matter itself to not just adapt to our needs but to heal, regenerate, and transform the world we share. Of course, while we marvel at the ability to play with nature's code, there's a whole new level of ethical and societal implications to think over. Progress always comes with a plot twist, after all.



Quantum: Being Safe, Feeling Safe

Safety first, second and third. We feel safe, encrypted, but are we really? In 2024, post-quantum cryptography entered the news. Laws changed and the rest is history, or is it? The National Institute of Standards and Technology (NIST) standardized quantum-resistant cryptographic algorithms. 'Big tech' had no choice: Apple, Google, AWS, and Microsoft set a new benchmark by transitioning to quantum-safe encryption, especially for sensitive data.

Industries are lagging in adoption, underestimating the urgency and complexity. While the financial services sector has been proactive, other sectors need to accelerate their efforts to meet regulatory expectations and future risks. It is not just us, it is the institutions, G7 and Europol, urging the rapid adoption of PQC standards.

Encryptions will crumble, leading quantum hardware providers optimistic roadmaps. Estimate 5-10 years. But the threat of 'record-now-decrypt-later' attacks means that the migration to quantum-safe encryption must start well before a cryptographically relevant quantum computer becomes operational. Consequently, NIST has released guidelines deprecating asymmetric encryption by 2030. The Commercial National Security Algorithm (CNSA) roadmap provides guidelines, indicating that firmware should default to quantum-safe solutions by 2025, with web traffic, operating systems, and niche equipment to follow in the years leading up to 2030.

Firstly, organizations should create a comprehensive and ongoing cryptographic inventory. Then, they should prioritize systems and data for migration. Migrating public-key cryptography to quantum-safe options will require deliberate planning over multiple years, taking interoperability and performance into account. Systems that cannot be updated, in particular, will incur significant costs and effort. Identifying these systems as soon as possible and considering replacements, along with updates to procurement policies to stop buying anything without a roadmap to support post-quantum cryptography, is crucial.

In a world where encryption crumbles and quantum looms, being 'safe enough' is no longer enough. The race for quantum-safe security isn't just about technology — it's about outpacing tomorrow's threats today. Because nothing feels less safe than realizing the future cracked your secrets while you were still planning for it.

And so, the pendulum swings, between the known and the unknown, the possible and the improbable. Progress is always a matter of balancing, daring us to explore what might be next while keeping an eye on what is key now. The future waits — not with answers, but with the questions that will shape it.

The **TechnoVision** 2025 Team

TechnoVision Core Team

Pascal Brier
Ron Tolido
Patrice Duboe
Michiel Boreel
Alex Bulat
Robert Engels
Cara Antoine

Marketing Contact

Esther Buck

With Special Thanks To:

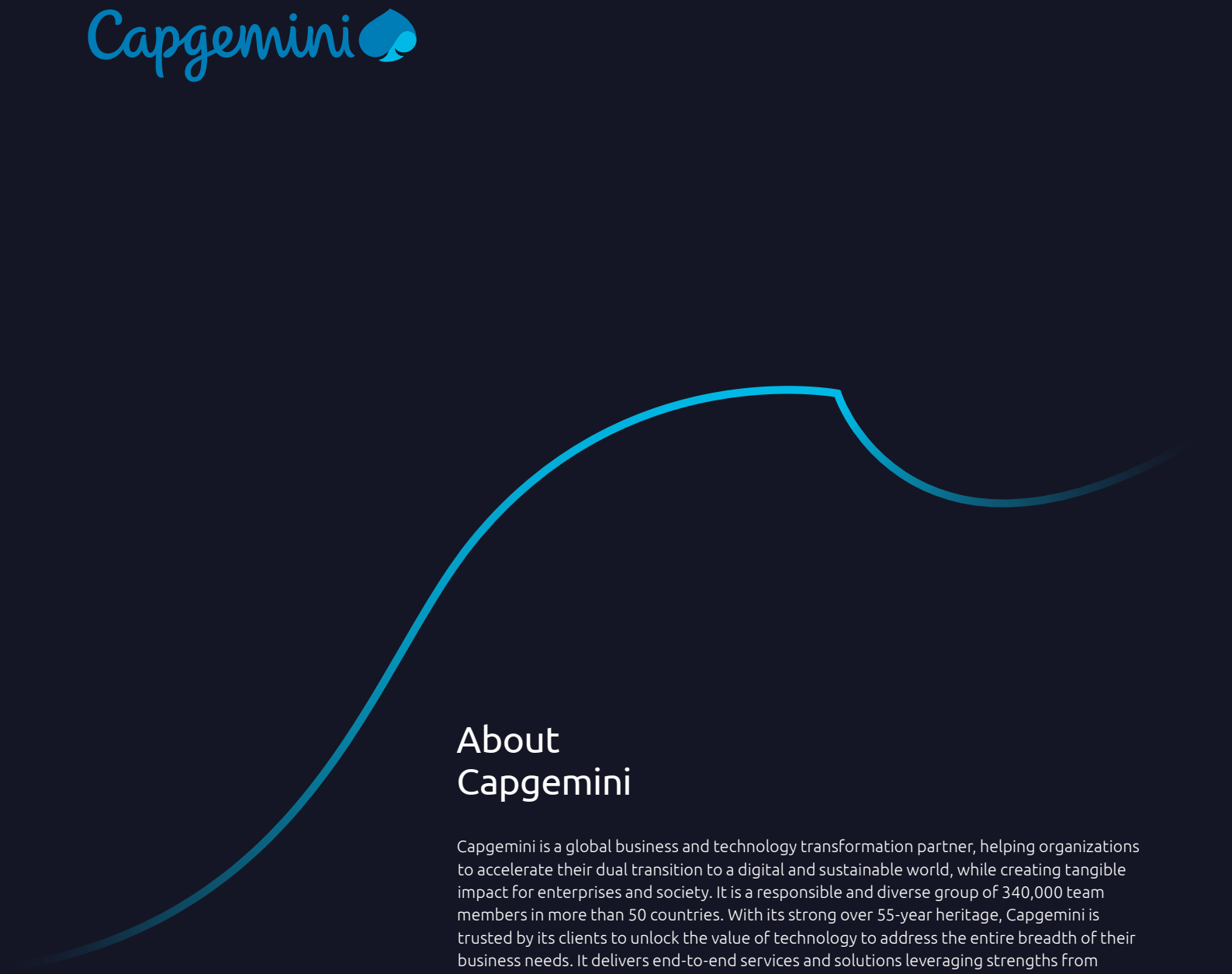
Pierre Hessler, Bob Schwartz, Lucia Sinapi, Belinda Rosario and the Emerging Technology Team, Lucie Calschi, Mansi Verma, Madhusree Ghosh Sen, plus all other friends of TechnoVision.

TechnoVision Masters & IdeaFest Contributors:

Abhijit Sawant, Muhammed Ahmed, Andrew Fullen, Ashish Tiwari, Atul Kurani, Aurobindo Saha, Bernd Wachter, Bob Schwartz, Caroline Ball, Cornelia Görs, Cristina Juliani, Daniel Koopman, Dany Tello, Deepa Nayak, Eric Fradet, Faizal Mustak Shaikh, Eduardo Ferreira, Gael Prudhomme, Hans van Rijs, Henk Vermeulen, Janhavi Padgaonkar, Jerome Desbonnet, Julian Van Velzen, Keerthi Guggila, Leon Smiers, Ludovic Toinel, Manuel Sevilla, Per Poulsen, Pierre-Adrien Hanania, Pierre Olivier Vanheeckhoet, Pradyumna Pendse, Pranav Kumar, Ramki, Robert Engels, Sander Bosman, Sander Van Lingen, Sarah Saunders, Sergio Compean, Sonal Chaturvedi, Sudarshan Sahu, Thilo Hermann, Yashowardhan Sowale

Experts in Residence:

Alexandre Embry, Carolina Sanchez, Monika Underwood, Nitin Dhemre, Krystianne Avedian, Jacques Bacry, Sudhir Pai, Keerthi Guggila, Rajesh Iyer, Melissa Swift, Neha Punater, Muhammed Ahmed, Robert Engels, Rajashree Das, Padmashree Shagrithaya, WeiWei Feng, Barbara-Anne Bensted, Gita Babaria, Cara Antoine, Anastasia Karatrantou, Manuel Sevilla, Priya Ganesh, Lee Beardmore, Alex Bulat, Thilo Hermann, Khambampati Sailu, Sarah Saunders, Ludovic Toinel, Sjoukje Zaal, Borja Tinao, Dapo Adekola, Bernd Wachter, Daniel Koopman, Shamik Mishra, Jennifer Marchand, Julian van der Velzen, Michiel Boreel, Ron Tolido, Aliasgar Muchhala, James Robey, Patrice Duboe



About Capgemini

Capgemini is a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 340,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2023 global revenues of €22.5 billion.

Get the Future You Want | www.capgemini.com